

**WHAT EVERY INDIAN 25  
SHOULD KNOW ABOUT HINDUISM**

**WHAT IS  
&  
WHAT IS NOT HINDUISM**



**DR.N. GOPALAKRISHNAN** Ph.D.; D.Lit  
(Scientist)

**INDIAN INSTITUTE OF SCIENTIFIC HERITAGE  
THIRUVANANTHAPURAM 695 018**

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**Heritage Publication Series - 80**

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*In the service of the motherland and dharma*

***IISH Publication Team***

For knowing Hinduism  
You should know  
the scientific meaning of  
The Customs and Rituals of Hinduism.  
The Literature and Message of Hinduism.  
The Spirituality and Symbolism of Hinduism.  
The Scientific and Technological Heritage of Hinduism.

For knowing all these, it will take more than a  
hundred janma/birth for you!

All the knowledge present in Christianity put together  
could be printed in one book. - The Bible

All the knowledge present in Islam put together could  
be printed in one book. - The Koran

But all the knowledge of Hindus is so vast that it  
can not be printed in one book. So the Hindus have 4  
Vedas, 19 Brahmanical books, Aranyakas, 108  
Upanishads, 18 books, each under Siksha - Nirukta -  
Vyakarana - Chanda sastra - Kalpa sastra Vedangas, 18  
Mahapuranas, 18 Upapuranas, 2 Itihasas, 6 Darsanas  
and 5 Upavedas..... an unending list of Hindu/Indian  
heritage.

If one copy of each of the above books is placed  
one above the other, it is said that the pile will have the  
hight of 4 telephone posts. Hindus knew that the ocean  
of human knowledge is so vast that it cannot be  
presented in one book by one man or by one saint. Here  
is an outline of Hindu knowledge.

## THE SCIENCE OF CUSTOMS AND RITUALS IN HINDU DHARMA

What is the definition of a Hindu? : *Aa sindho: sinduparyantham yasya bhaaratha bhoomikaa maathru bhoo: pithru bhoo (punya) schaiva sa vai Hindu iti smruthaa:* whomsoever, is considering the land between the sapta sindu (Indus valley river) upto Indian ocean as the motherland/ fatherland and holy land, is known as Hindu. This land is known as *Hindustanam* which is defined as follows: *Himaalayam samaarabhya yaavath hindu sarovaram tham deva nirmitham desam hindustaanam prachakshate.* The land created by god himself and which is lying between Himalayas and Indian ocean is known as *Hindustanam*.

Unlike other religions, Hindu dharma has many specialties. This is not known as a religion, it is known as the dharma. Either *Hindu dharma* or *sanaathana dharama*. *Sanathana* means according to *bhagavath geetha*, which cannot be destroyed by fire, weapons, water, air, and which is present in all living and non living being. Dharma means, the way of life which is the 'total of all aacharaas or customs and rituals'. The aacharaas which are to be performed by the mother is known as *mathru dharma*, those of father is known as *pitru dharma*. Similarly there are *putra dharma* (dharma of son) *aacharya dharma* (dharma of teacher), as a continuation we can say *bhraathru* (brother) *dharma*, *bhagini* (sister) *dharma*, *poura* (citizen) *dharma*, *raja* (king) *dharma* and so on. All these dharmas have been described in detail giving the specific importance in the *dharma saastra* and *smruthies*. There is no specific English word for dharma, but it is the sum of the duties + responsibilities + privileges of that individual. Then what is the *sanathana/ Hindu dharma*? It is the total of *mathru dharma* + *pitru dharma* + *putra dharma* + *putree dharma* + *acharya dharma* + *poura dharma* + ... + ... etc. Hence we say Hinduism is not a religion but the way of life.

One should always remember that in each and every aacharaas / dharma there will be a component of spirituality in it. Without spirituality, nothing exists in Hindu dharma. Almost everyone



carries a wrong impression that this spirituality is religion. No ! spirituality is different in Hindu dharma, where the question of religion does not exist at all, because Hindu dharma was not created by one individual/prophet/incarnation/.... Hence it is not a religion. Spirituality is a part of every Hindu custom.

What are the rules to be followed while practicing the Hindu customs and rituals (aacharaas) ?. This question has to be scientifically analyzed. Whatever may the aacharaas we are practicing in our life, it has been told that *saakshaath anubhavairdhrushto na srutho na guru darsitha lokaanaam upakaaraaya ethath sarvam pradarsitham*. Aacharaas are to be followed based on their merits available from the self experience, one need not blindly follow a teacher or someone who gives advise without reasoning. All these aacharaas are mentioned for the prosperity of the human beings and it should be the prime focus for practicing the Hindu aacharaas.

*Acharyaath paadam aadatthe paadam sishya swamedhayaa paadam sa brahmachaaribhya sesham kaala kramena cha* is another important advice given in smruthies. It means one can get one quarter of the knowledge from the teacher, one quarter by analyzing oneself, one quarter by discussing with others and the last quarter one can get during the process of living by the method addition, deletion, correction and modification of already known aacharaas/ new aacharaas.

It is mentioned that we have to take one quarter from the teacher/guru. Now, what is the definition of a guru or teacher. *Aachinothi cha saastrarthaan sishyaan saadhayate sudhee swayam aacharti chaiva sa acharya iti smruthaa*: who is knowing the scientific meaning of the purpose of the aacharaas, who can teach the student very systematically and who is following (all what is taught to the students) in ones own life, that person is fit to be called as the teacher/guru. Here, one can see the qualification of a teacher who can define and explain about the aacharaas.

Can we practice the aacharaas at all times with the same level of

devotion ? This is a common question asked. The answer is also given in our smruthies. *Swagraame poornam aaachaaraasasm anyā graame thadardhakam pattane tu thath paadam yaatre baalaad aaachaaraasastheth*. In one's own village, practice all the aachaaraas, in other villages (while travelling or staying) practice one half of the aachaaraas, in the cities/ towns follow atleast a minimum of one quarter of them and while traveling, like a child one need not practice any of the aachaaraas.

Should we practice the aachaaraas blindly saying that those aachaaraas were followed by my father or forefathers.? *Thaauthasya koopoyam iti bruvaana kaa purusha kshaarajalam pibathi*. Saying that this well was dug by my father ( and for showing respect to him) one need not drink the salt water (if it is present) in the well.

Aachaaraas need not be the same in Kerala and Kashmir, similarly for a Hindu the same customs cannot be practiced in America and Rajasthan desert. Hence depending upon the place , time, season, age, availability of the materials, financial position of the individuals, the aachaaraas can be duly modified.

The same principle one can see in bhagavath geetha also. Lord Krishna told Arjuna in the end of Bhagavath geetha, that *vimrusya ethath aseshena yathaa icchasi thathaa kuru*: Hey Arjuna all those whatever I have told you, critically analyze, and the option for accepting or rejecting is yours.

These are the rules one should follow while analyzing and practicing the aachaaraas in Hindu dharma. There are many words of guidance given in dharma saastra book. *Saastram pramaanam* : scientific results are the first basis, *aapta vaakyam pramaanam* : guidance to be taken from the scholars is the (next ) basis, *prathyaksham pramaanam* : the direct experience is the next basis, *anumaanam pramanam* guessing the consequences/results, if none of the above parameters is available. These are the steps one should select for the analyses of the aachaaraas.

What are the purposes of practicing the aachaaraas ? It has been described in the smruthies ( which are also known as



dharmasastras) : *aacharaath labhathehyaayu: aacharaath dhanamakshayam aacharaath labhathe suprajaa aacharo ahanthya lakshanam* . By following the aacharaas one gets health and longevity, it leads to prosperity, it gives social relations and friends, and the followers of aacharas are considered as the embodiment of nobility. *Aachara heenam na punanthu vedaa:* The person who does not have the habit of practicing the good *aacharaas*, cannot even be purified by Vedas.

What are the aacharaas ? those customs and rituals which are irrelevant in the modern times are known as *anaacharaas*, those which lead to negatives/ deleterious results are known as *duraacharaas* and those *aacharaas* which give very positive and useful results are known as *sadaacharaas* or generally known as *aacharaas*.

The *sadaacharaas* are followed for, any one or more of the following purposes in the Hindu dharma. **The aacharaas are those give psychological, physiological, family relation and bondage, social relations and bondage and national integration based positive results.** Focusing on the above five points one can analyze very systematically all these aacharaas.

**Psychologically beneficial aacharaas/ customs and rituals:** Few examples are selected for explaining these type of aacharaas. The morning and evening prayer, the positive songs and *keerthans*, the Vedic *mantras* which produce psycho linguistic and neuro linguistic effects, etc are psychologically useful aacharaas. They give extremely good response in the brain cells by way of producing curative hormones. The blessings of the elders and parents, the encouragement given to the children and also to those who are desperately struggling in the life, the words of consolation, the blessings like *vijayee bhava*, the aacharaas in social gathering and family functions, etc give psychologically positive results. (All these aacharaas are also spiritually connected, is the Hindu way)

**More examples:** Reading a puraana gives the messages of ups and downs/ failures and success/ pains and pleasures in the life.

The stories of Sri Rama in Ramayana and that of Pandavas in Mahabharatha inform us that there are sufferings in the life and everyone should face them boldly. Reading Bhagavath'geetha is for mentally preparing to face any type of consequences and without failure practicing the swadharama (ones own duty). Through puranic story telling for the children , value based messages are given in the form of story capsules to remain in the memory for many years and to get the reminder whenever the abnormal pathway is opted to in their life. Visiting elders on festive occasions is for getting value and experience based advise from their life. Respecting teachers and elders, is for keeping the values in ones life and in society for the learned people who continue to guide the society. Auspicious time selection for visits and performing ceremonies, is to take extra mental precaution to see that everything is carefully / systematically programmed and planned . Consulting a good astrologer is to see that things are meticulously planned and the blessings of the Vedic devathaas are assured for an optimism in ones endeavor (however this should not go to the level of superstition and should be carefully monitored). Performing pooja is mainly to see that good will come if good is practiced . And to give the feeling that rest is left to the divine mercy/ blessings. This blessing is directly assured (at least we feel so) by conducting poojas in presence of family and relatives (hence gives an opportunity for the family members to come together also). Worshiping the idols/ images having smiling faces (*prasanna vadanam*) gives a psychological positive feeling of confidence ( avoid the worship of weeping/ bleeding/ cruel images as it gives a negative influence in the mind). Chant positive *manthra/ keerthan/ bhajan* for positive effect (neurolinguistic and psycholinguistic) and never chant crying or weeping songs which also influence the mind negatively

**Physiologically beneficial customs and rituals.** You can also analyze these customs and rituals yourself on the scientific base. The *soorya namaskaara* / sun salutation performed in the morning is a combination of 7 yogaasanaas practiced in ten

steps, which give smooth exercise for all the movable skeletal joints in the body and hence this is also known as 'the king of the exercises'. Morning prayer *karaagre vasathe lakshmi karamadhye sraswathi karamoole sthitha gouri prabhaathe karadarsanam*: Sitting in the same bed where you sleep everyday, without cleaning the teeth-face-body, why this manthra is chanted, because the body was horizontal for the whole night while sleeping and it is going to become vertical (suddenly) when you get up. In the vertical position of the body the force exerted by the heart for pumping the blood is more, hence the change of position of the body from horizontal to vertical level should be slow and steady. Hence we are instructed to sit on the bed for few seconds (it has been statistically estimated that 23% of the heart attack deaths take place in the heart patients when they suddenly get up and stand/walk from the lying position). Similarly with a mantra we touch the floor *samudra vasane devi parvatha sthana mandale Vishnu patnee namasthubhyam paada sparsam kshamaswa me*. The bio static electricity in the body gets earthed through the fingers instead of the feet, reducing the chance of arthritis and many other nervous based disorders. Before taking the food, few second prayer is a Hindu aacharaas. during this prayer time and while looking to the food the flow of saliva in the mouth takes place and this liquid activates the generation of other digestive enzymes also, thus activating the process of digestion (a layer of saliva and digestive enzymes in the bottom of the stomach before the food comes to the stomach is a biochemistry). Fasting leads to cleaning of the intestine, certain fasting (partial) in which change of food is instructed in the custom, which leads to getting variety of micro nutrients from different types of food sources. *Choodaakarna* the ceremony connected with wearing of the ear ring is just like giving the first vaccination and *annapraasana* the first food giving ceremony is like the first inoculation to the baby through the hands of different people (the ear ring in the former and food in the latter carries little dirt/germs which leads to augmenting the immunity in the



body of the baby). These are only very few among thousands of *aacharaas* practiced by Hindus, for physiological benefit

**More examples:** Do not keep the direction of the head towards north because the magnetic meridian of the earth retards the blood flow through brain capillaries and affect the functioning of brain cells. Avoid taking bed coffee to prevent the obnoxious decomposed materials generated by microorganism in the mouth (in the night) going to the stomach to avoid the chance of stomach cancer. Wake up early morning, because the brain is perfectly active during that time. Take a bath in the morning itself so that all the decomposed products/ salts/ urea etc present on the surface of the body gets cleaned which prevents the skin diseases significantly. The cold water/ hot water bath activates the biological process of the body cells to maintain the body temperature when cold/ hot water bath is taken. *Dhyaana* / meditation activates brain cells. *Praanaayaama* activates the lungs cells and functioning. Taking *thulasi* water/ *theertha* gives the medicinal property of the plant in it. Using sandal wood paste in the forehead gives the chance of absorbing the medicinal components in the *chandan* through the most sensitive part of the body. Visiting a temple (in Hindu worship, the temples are not merely prayer halls, they are quantum healing centers) gives energy to the body if *pancha suddhee* is maintained. Doing *pradakshina* to *aswatha* gives an atmosphere/ air through which traces of ozone produced by the tree goes to the lungs and purifies the lungs. Attending and participating temple festivals give the opportunity for leadership qualities, social gathering, entertainment and hence variety of merits including spiritual benefits.

**Customs and rituals beneficial for strengthening the family bondage:** When we look for integrated development of the society, the family relation becomes the first step in the social life. There are hundreds of *aacharaas* in the *Hindu* life which are exclusively aimed at strengthening the family relations and bondage. Every spiritual and family based customs are to be practiced by the wife and husband together, This strengthen the

family relationship. The message that *maathru devo bhava, pitru devo bhava* : Let the mother and father be divine to me ( gods to me) convey a strong relation thread between the children and parents. The death anniversary functions known as *sraardha* are mainly performed to give the demonstration of the relationship between the parents and children. The demonstration from generation after generations.

In all the rituals, the individual is expected to tell the *gotra* (clan) and *sootra* (thread of connection) which again show the connection with the forefathers. During festivals, the parents were saluted/prostrated as *mathru/pithru namaskaara*, to get the feeling for the children that ( whatever may be their age) their relationship, with the parents is not merely that of people living together in a house. This gives the message that in younger days children were looked after by the parents and in the old age, the parents should be looked after by the children with due respect and care. Similarly the relationship between the wife and husband is not merely the relation for sex, but for building a family with culture and values in the life. Through 16 sacraments known as *samskaaraas* ( *samskaara* means refining or purification) the life of the baby is getting enriched by the values of the life. During the construction of the house the ground breaking , stone laying , the door fixing and house warming ceremonies are all connected with the star of birth of the wife, thus giving importance to the wife in the family. Without the husband or wife, the other (among the couple) alone cannot perform any of the household *achaaras*, which again makes it compulsory to build the strong family bondage. The marriage is performed by tying the thread- putting the garland- holding the right palm (*paanigrahana*)- presentation of the cloths or exchanging the rings- and by *sirodhaara*, these five rituals in presence of hundreds of invited guests/ and *agni*/ fire give the feeling of strong wife – husband bondage. It is said that the marriage is conducted as *agni saakshi*. Thus one can analyze the customs to understand the impact of the family relations.



**More examples:** If properly performed matching a horoscope before marriage gives an opportunity for understanding the personality of the individuals who are getting married and suitable corrective measures can be adopted. Inviting relatives and guests for marriage gives an opportunity to share the joy among relatives and social and family relations get strengthened. After marriage ceremonies are aimed at getting a healthy baby and giving the feeling of love and affection among the couples. The *jaatja karma* of the baby is performed to record scientifically the position of the celestial body when the baby was born. It is the bound privilege of the parents to give the name for their baby and hence the name of their choice through *naamakarana*, is given as a part of the *samskaaraas*. *Dhampati pooja* couple pooja is performed by other family members to remind their respect and appreciation on strengthening the bondage between the couples. Birthday celebrations are conducted to inform the duty and responsibility of the individuals when they grow and to remind them that the society and relatives are with them for undertaking the responsibility. Celebration of the 60<sup>th</sup> birth anniversary (*shashti poorti*), to remind the time for doing more good for the society using the experience gained for the last 60 years of life, when the period of rest starts.

**Customs and rituals beneficial for the social bondage:** Inviting guests for family functions like birthday, marriage, during the death and after death rituals, getting together during the festival seasons like holi-deepavali-krishnaashtamai-ramanavami-celebrations etc. temple festivals, village festivals, are all aimed at building social bondage. Through these social relation building mechanisms the cultural relationship among Indians was built up for the last many millennia. Many spiritual and religious activities as *samooha pooja*, *samooha bhajan*, *mantra aalapan* etc are all done in groups with the leadership of the common Hindus themselves, not through appointed priests, which lead to the cultural integration of the social bondage in the Hindu society.

**More examples:** Family visits during happy and unhappy occasion by relatives and friends ( even without taking appointments) is to confirm the family members that during happy and unhappy incidents in ones life we , the relatives and friends will be with them. Get together during festival occasions is for strengthening social bondage among the society members. *Kumbha mela, vaisaaki*, and many other festival is for sharing the joy and forgetting the negatives of the past and to build better relations ship among the members in the society . Group pilgrimage to long distance is to share the joy and difficulties together in the spiritual way to strengthen social bondage...

**Customs and rituals beneficial for national integration:** There are many customs which are followed exclusively for getting the feeling of patriotism among the Indians. The morning prayer (*praathasmarana*) we chant the names of seven holy rivers from Indian continent ... *gange cha yamune chaiva...* and seven mountains.. *mahendro malaya sahyo...* the great women of India... *ahalya droupadi seetha...* the great men *aswathaama bali vyaaso....* Seven major cities of India *ayodhya mathuraa maaya....* and so on. These stanzas were written three or four thousand years ago. This informs and reminds us that India was culturally one for the last many thousand years The pilgrimage to north India by the south Indians and to south India by the north Indians are fine example of national integration. The customs followed in the immersion of the ashes (obtained after cremation) in *kaasi / varanaasi triveni sangam* by the south Indians and in *kanyakumari triveni sangam* by the north Indians lead to this national integration through visits and experiences of direct contact among south and north Indians ( where the languages/ food/ dressing/ cultural traits etc differ).

It is also important to note a very interesting fact, that for making any curries (food items) in south India , north Indian spices are required and for north Indian curries, south Indians spices are inevitable. Thus even in kitchen of Hindu family, the national integration can be seen. Learning of Sanskrit language, chanting of Vedas and related literature, the story of Ramayana and

Mahabharatha are all finally aims at integrating the people of India and give the message of unity in diversity .

**More examples:** A deep analyses of the holy places, rivers, mountains and asramas given in Ramayana and Mahabharatha when Sri Rama ( in Ramayana) and Pandavas ( in Mahabharata) visited during vanavaasa , give familiarity of the nation through itihasas and puraanaas. Puranic stories do influence the national integration. Pilgrimage to Aśrams, Gangotri, Haridwaar, Kailash, Kanyakumari, etc integrates the mind of all Indians towards the nation. The concept of *athithi devo bhava* to serve the people who visits our home without taking appointment gives the opportunity to know and help others. During the age old customs anyone who is on pilgrimage has to depend for the food and shelter upon the unknown people . People traveling from north to south and south to north of India, for the pilgrimage could take the shelter in the *athithi devo bhava* concept. Bharath maatha ( mother Bharath) concept of the nation gives the relation among Indians as the children of the country. In mahasankalpa names of different kshetra in India are given ( as *parasurama kshetra* ( Keralam) - *Sri Rama kshetra* ( Tamil Nadu) - *Sreenivasa kshetra* ( Andra) - *Jagannatha kshetra* ( Orrissa) - *Bhaskara kshetra* ( Karnataka) and so on, which informs us that we are part of the great nation Bharath. Like this there are hundreds of the aachaaraas aimed at national integration.

Thus the aachaaraas are directly connected with the day to day life of Hindus. Even the spiritual rituals also compels us to pray *saha naa vavathu, saha now bhunakthu saha veeryam karavaavahe thejaswinaavadheethamstu maa vidvisha vahai aano bhadraa* . Let us exist together, share the results of the work together, work together, thorough that path way let us enlighten ourselves, let us not have hatred towards anyone , let noble thoughts come from all over the world. Hindus always prayed *lokaa: samasthaa: sukhino bhavanthu* . let everyone become happy. Hindus never prayed *haindavaa: samasthaa: sukhino bhavathu* Let (only) Hindus become happy. Hindus never



said their pathway is the only correct one for attaining god. They always allowed other thoughts also to penetrate/integrate into the minds of the people, if those pathways can also fetch good results. Hindus are the only people who prayed *sarve bhavanthu sukhina: sarve santhu niraamaya sarve bhdraani pasyanthu maa kaschit dukhabaag bhveth*. Let *sarve*- all become happy and glorious, free from pains and sorrow. Here too Hindus never said only let Hindus get all the benefit

Say that all Indians are proud Hindus whether they follow lord Siva, Krishna, Jesus Christ or Prophet Mohammed, if their blood is Hindu blood then they are Hindus. In India there are only two categories of people who are Hindus and who were Hindus. Those, who are following the sanathana dharama, even though born and brought up under different culture anywhere in the world, are also Hindus.

### **HINDU (VEDIC AND RELATED) LITERATURE**

Christianity is based on one holy book, the Bible and the Islam is also based on one book Koran. But the Hindu dharma is based on many books such as Vedas, Vedaangaas, Puraanaas, upa puraanaas, smruthies, upa vedaas and itihaasaas. Since human knowledge is so vast, it is impossible to comment on that heap of knowledge in one book. Hence the Hindu Rishies wrote thousands of books and commentaries under specific titles. A Hindu can select the subject(s) of his choice. We, in our earlier publications have scientifically explained the Hindu aacharaas, Hindu spirituality, scientific and technological heritage of Hindus and now, it is necessary that every Hindu should understand what are the Hindu literature, atleast in a nutshell.

Hindu dharma is based on Vedas (the word Veda means knowledge). Vedas are foundations of Hindu dharma. All other Hindu literature are directly or indirectly linked with Vedas. There are four Vedas. They are Rigveda, Yajurveda, Samaveda and Atharva Veda. Vedas are known as anaadi because their period of composing is not correctly known. The authors of these

manthraas are known as manthra drushtaara, means those who could see the manthra when they composed them. Vedas are also known as apourusheya means composed by Rishies having the talent beyond the level of ordinary human beings. All these manthras are classified by Maharshi Krishna dwaipaayana, who was later known for his meritorious work as Veda Vyaasa who was born to a fisherwoman, into Rig Veda, Yajurveda, Samaveda and Atharvaveda.

## ANALYSES OF VEDAS

**Analyses of Rigveda:** Rigveda is the oldest book of the human race. It might have been composed many thousand years ago. It is composed by hundreds of Rishies and their names are given in the beginning of each sooktha. It is written in poetical style/language, known as Riks, The Riks (stanzas) put together becomes sookthas.. Rig Veda has 25 recensions of which only five are available now. They do not differ significantly. The available recensions are known as saakala saakha, baashkala saakha, aaswalaayana saakha, saankhaayana saakha and maandukeya saakha

The most popular Sakala saakha of Rigveda has 64 chapters. Manthras are classified into 2024 Vargas which are made out of 10552 Riks. These manthraas are composed with a total number of 193816 Sanskrit words. There are 397265 letters in Rigveda. Some of the names of the Rishies who composed the Veda manthras are Kasyapa, Viswamitra, Kanwa, Paraasara, Gouthama, Bharatha, Vamadeva, Gopayana, Athreya, Aangeerasa, Bharadvaja, Sounaka, Gargya, Praagaatha, Vasishta, Yama, Samvana, and so on.

**Analyses of Yajurveda:** More than one half of the manthras in Yajurveda is taken from Rigveda and remaining composed by Rishies of Yajurveda. It is said that there are 100 recensions for the Yajurveda. Names of some of these recensions are: Aalambhi, kalinga, kamala, ruchaabha, aarunee, thaandya, syaamaayana, kata and kaalaapi. The Kata saakha has been further separated into charaka kata, aahwaraka kata, bhraajishtala kata, kapishta kata,



chaaraayaneeya kata, praachya kata, swetha kata, swethaswethara kata, oupamanyava kata, paathaandineya kata, maithraayaneeya kata,..... and so on. The series go upto one hundred recensions. Few of the Yajurveda recensions have only poetical manthras and the remaining have both poems and prose. All the recensions which have only poems are known as Sukla Yajurveda and other set is known Krishna Yajurveda. All these recensions together is known as the tree of Yajurveda ( Yajurveda vruksha). There are 40 chapters in the Sukla Yajurveda recensions and in other recensions the number of chapters vary. The 40<sup>th</sup> chapter of Sukla Yajurveda is Eesaavaasya Upanishad, the only Upanishad coming as a part of any Veda

Analyses of Sama Veda : This Veda is chanted by specialists known as udgaatha, means musicians of vedic traditions, and the manthras are highly complicated music in nature. There are 1000 recensions for Sama Veda and only 13 are now available. Some of their names are: Raanaayaneeya, saatyamugra, Vyaasa, bhaguree, oulundee, goulguvi, bhanuman, kaaraatee, masaka, kouthuma, saaleehotra, jaimineeya, and soon. There are total 1861 manthras including 267 repetitions ( punarukti) . By tradition some of these manthras can be chanted only in village environments ( graama geya ganaas), some are only in forest ( aaranyageya gaanaas), some are to be chanted at very low voice (ooha gaanaas), some are permitted only in the mind (sound should not be heard outside) known as oohya gaana. In Jaimineeya recensions of Sama Veda, it is said that there are 1232 graamageya gaanaas, 291 aaranyageya gaanaas, 1802 ooha gaanaas and 356 oohya gaanaas. Generally the Sama Veda mantras are chanted during yaagaas.

Analyses of Atharvaveda: It is said that there are 50 recensions for Atharvaveda. The recensions now available are only 9. pippalaada, thouda, mouda, sounakeeya, jaajala, jalada, brahmavada, devadarsa, and chaarana vaidya. There are nearly 6000 manthras in Atharvaveda of these 1200 manthras are taken from Rigveda. Atharvaveda is more social in spirit than the other

three Vedas. This Veda is also known in different names like kshetra Veda, Brahma Veda, Aangeerasa Veda, and soon.

### ANALYSES OF BRAAHMANAS

Brahmanaas some times come as the part of Vedas (as in Krishna Yajurveda) and generally they are separate books. They describe the method of yaagaas and customs and rituals for conducting the yaagaas. Generally it is difficult to understand the explanation of the subject without the commentaries. For Rigveda there are two Brahmanaas known as aithareya brahmana having 40 chapters, the second one saankhaayana brahmana having 30 chapters. Both explain the ritual connected with the yaagaas. Yajurveda has Sathapatha Brahmana composed of 100 chapters in one saakha and in the other saakha it has 104 chapters, which give many historical information on ancient India Bruhadhaaranyaka Upanishad is a part of this brahmana. The second brahmana of Yajurveda is thaithireeya brahmana (this becomes almost as a part of Yajur Veda itself, unlike other brahmanaas) in which thaithireeya Upanishad, mahanaaraayaneeya Upanishad, yaajnikее Upanishad are included.

Samaveda has the following separate braahmanaas: thaandya – Upanishad – jaimineeya- devathaadyaaya – samhithopanishad-vamsa- arsheya- shadvimsa- cchandokhya brahmanaas are the most important among the samavedeeya brahmanas. Cchandokhya upanishad is a part of cchandokhya brahmana. Atharvaveda has only one brahmana known as gopatha brahmana.

### ANALYSES OF AARANYAKAAS

Aaranyakaas generally comes at the end of the brahmanaas or as a part of separate book. They are more philosophical or spiritual in subject. In Hindu dharma, there are four stages in life such as brahmacharya, gruhastha, vaanaprastha and sanyaasa. When one reaches the stage of (Vaanaaprastha) leaving the house and go to forest, the rituals are to be performed with utmost simplicity and these rituals are explained in aaranyaka. Rigveda has aithareya aaranyaka as a continuation of the aithareya brahmana. In this aaranyaka comes the aithareya Upanishad, mahaitareya

Upanishad, bahvrucha Upanishad and samhithopanishad. In Koushectakee aaranyaka of Rigveda comes the kousheetake Upanishad. Yajurveda has maithraayaneeya aaranyaka in which maithraayaneeya Upanishad comes. And in thaithireeya aaranyaka comes thaithireeya Upanishads. Sama Veda and atharveda do not have separate aaranyakaas, but the philosophical and spiritual subjects explained in the aranyakaas are coming in some part of the brahmanaas .

### ANAYASES OF UPANISHADS.

Upanishads are the philosophical and spiritual treasury of Hindus. The great messages of Bharath come from the Upanishads. They describe about the pancha praana, pancha bhootha, pancha karmendriya , pancha jnaanendriya and mind. They also describe in detail on specific spiritual aspects and rituals. The Upanishads are classified into five groups. Those belonging to Rigveda are 10 numbers. Upanishad belong to sukla Yajurveda are 18 in number. Those belong to Krishna Yajurveda is 32 and 16 Upanishads for Sama Veda and 32 for Atharvaveda. Each class of Upanishads have separate santhi manthraas. Only one Upanishad comes as a part of Veda, that is the eesaavaasya Upanishad. Few Upanishads as mentioned above come as part of braahmana texts few other come as part of aaranyakaas. Remaining are separate Upanishad texts.

Rigvedeeya Upanishads : aithareya – kousheetakee- naadabindu-aathmabhoda- niravaana- mulgala-akshamaalika-thripura-soubhagyalakshmi- bahvrucha Upanishads belong to the class of Rigveda with saanthi mantra commencing from vang me manasi prthishtithaa.....

Sukla yajurvedeeya Upanishad: eesaavaasya- bruhadaaranyaka-hamsa- paramahamsa- subaala- manthrika- thrisikhibraahmana-niraalamba- mandala braahmana- advaya- thaaraka- bhikshuka- adyaathma- muktika- thaarasara- yajnavalkya- saatyaayana-thureeyaatheetha avadhootha Upanishads belong to the suklayajurvedeeya class with the saanthi manthra commencing with poornamatha poornamidam....



Krishna yajurvedeeya Upanishad: Kata- thaithireeya- brahma-kaivalya- swethaaswethara- garbha- mahaanaraayana- amruthabindu- amruthanaada- kaalagnirudra- kshurika- sarvasaara- sukarahasya- thejabindu- dhyaana bindu- brahmavidya- yogathathva- dakshinaamoorthy- skanda- sareerika- yogasikha- ekaakshara- akshi- avadhootha- katarudra- rudrahrudaya- panchabrahma- praanaagnihotra- vaaraaha- yogakundalini- kalisantharana- saraswathee rahasya Upanishad are Krishna yajurvedeeya Upanishads, with the santhi manthra commencing with sahanaa vavathu....

Samavedeeya Upanishads: kena – cchandokhya- aarunee- maithraayanee- maithreyee- vajrasoochika- yogachoodaamany- vasudeva- maho(panishad)- sanyaasa-avyakta- kundikaa- saavithree- jaabaala- darsana- rudraakshajaabaala Upanishads with the saanthi manthra ..om aapyaayanthu mamaangaani.... belong to Sama Veda.

Atharvavedeeya Upanishads: prasna- mundaka- maandookya- atharvasira- atharvasikha- bruhadjaabaala- seeta- sarabha- mahaanaraayana- raamarahasya- raamathaapinee- saandilya- paramahamsa- annapoorna- soorya- aathma- paasupatha- thrupurathaapinee- dehee- parabrahma- bhaavana- bhasma jaabaala- ganapati- mahaavaakya- gopaalathaapinee- sreekrishna- hayagreeva- datthathreya- garuda- narasimhapoorvathaapinee- narasimha uttarathaapinee – naarada parivraajaka Upanishads belong to the Atharvaveda class and they have the saanthi manthra beginning with: Bhadram karnebhi srunuyaama devaa .....

#### **ANALYSES OF VEDAANGAAS:**

Vedaangas are books connected with Sanskrit language used for writing the Vedas. There are six vedangaas. They are Siksha, niruktha, vyaakarana, chandas saastra, kalpasastra and jyothisha. The words vedaangaas mean the organs of Vedas (parts of Vedas) All the rules defined here for writing the Vedic Sanskrit are also applicable for modern and ancient Sanskrit literature . Thus one can see that rules and science of language are also given through Vedic literature. In each branch of Vedaangaas, it is said

that there are 18 books written two/ three thousand years ago. Additions, deletions, modifications and corrections are done when new books were written as original ones or as commentaries.

**Analyses of Siksha :** These books give the rules for chanting the vedas. The word siksha means 'learning/ teaching' – it is the learning of the Vedas. These are known in the names of great sages: Yajnavalkya, Vasishtha, Kaatyaayana, Naarada, Gouthama, Panini, Sounaka, Sisira, Aapisali - and so on.

**Analyses of Nirukta :** This is second among the Vedangas and this branch of study aims at teaching the formation of Sanskrit words used in Vedas. The roots of the vedic words and the modifications taking place when the words combine. The most authentic book is the Nirukta written by Yaaskaacharya. There are 18 Nirukta books of which important among them are known in the names of Oupamanyava, Gargya, Galava, Vaarshyaayane, Aagraayana, Saakapoorna, Aarnanaabha, Thaitik, Sthouleshti, Kroushtuka, Kaathyayana and so on.

**Analyses of Vyaakarana:** This is the Vedic grammar book, giving the grammar rules applicable for all the Sanskrit based literature written two to three thousand years ago. The most important among the vyaakarana books is the one written by Panini known as mahabhashya/ ashtaadhyayee having 2105 soothraas/ rules. The other important grammar books are known in the names of great grammarians Aapisali, Gaargya, Gaalava, Saakalya, Saakataayana, Bharadwaaja, Sphotaayana, and so on.

**Analyses of Kalpasastra:** There are four major subdivisions for Kalpasastra. The Kalpa sastra books discuss fully, the customs and rituals to be performed by each and every Hindu on individual- family- society and as a citizen bases. All the customs to be performed by a married couple in the family comes under the gruhyasootra. All the customs for performing the yaagaas and yajnaas come under the srouta sootra. The rules and customs to be practiced by the citizens/ officers/kings/ministers etc come under dharma saastra. The after death customs/rituals come under pitru-medha sootra. In fact all the Hindu rules/ rituals/



customs are discussed in detail with due corrections/additions/modifications/ and refinement (required in the course of time) , in these books.

**Analyses of Jyothisha:** This is the sixth vedaangaa, in which mathematics, astronomy and prediction part (astrology) are combined. There are hundreds of books written in ancient India on mathematics and astronomy which are the part of vedangaas. A few books are written on the prediction part of the Jyothisha. The first two parts are discussed in detail in the scientific heritage of India published by the Institute.

### **ANALYSES OF UPAVEDAAS:**

Upavedas are the science books which come as subsidiary- upa- to Vedas . For each Veda there is a subsidiary. They are Arthasastra, Dhanurveda, Gaandharva Veda and Ayurveda respectively for all the four Vedas. The Sthaapthya Veda/ vastu has also been given the status of the upaveda.

**Analyses of artha saastra:** Artha saastra is economics and the most authentic books in this class of ancient Hindu literature is the Koutileeyam- Chanakya's Arthasastra. This is an authentic arthasastra book with 6000 messages/ rules written in 150 chapters. Each and every line in this book has deep message to convey. There are 18 artha saastra books written in olden days.

**Analyses of dhanurveda:** The books describe on science of archery. All the informations connected with the war and use of weapons are described in the dharnurveda. The most authentic book in this branch of upaveda is said to be written by Dronaacharya namely Dhanurveda. Detailed description of the subject matter is given in the great Indian epic Mahabharatha.

**Analyses of Gaandharvaveda:** detailed decription of music, musical instruments, dance and related arts are given in the Gaandharva Veda text. This Veda is the upaveda of Samaveda. Sarngadhara's sangeetha ratnaakaram is one of the important books coming under this class. Yaamalashatakam, uddheesamahodayam, maansollasam, sangeetha darpanam are some of the important books.

**Analyses of Ayurveda:** This is the upaveda of atharveda describing the health, food and diseases in detail. The Charaka samhita, Susruta samhitha, Ashtaanga hrudaya, Ashtaanga samgraha etc are the reference books followed today for the ayurveda.

**Analyses of Sthaapathya Veda:** this has been given the status of upaveda of Atharvaveda. here one can read the rules and applications of Vaastu used for house/temple/ palace/ forts constructions

### **ANALYSES OF MAHAPURAANAAS:**

There are 18 Mahapuranaas and 18 Upapuraanaas. Through these puraanaas ancient Hindu Rishies convey the dharmic messages as the stories and histories of the kings/ kingdoms/ simple experiences of Rishies and so on. Sometimes the messages through simple stories connected with gods / human beings/ animals also come under the puranic explanations. All the information given in puraanaas are aimed at 'creating a scientific temper and realization of the facts and truths connected with our day today life'

**Names and analyses of 18 Mahapuranaas:** These mahapuranaas are huge volumes of books, many a times each written in 5 to 10 volumes with stories, histories, sub stories, upadesaas/ etc. The names of the puranaas : Vishnu – bhavishya- garuda- agni-mahaabhagavatha- siva- markandeya- linga- brahmavaivarttha-malsya- koorma- varaaha- vaamana- skanda- brahmaanda- padma-vaayu- naradeeya puranaas.

**Names and analyses of upapuraanaas:** It is said that these upapuranaas are less important when compared to the puraanaas. Their names are samba- devibhagavatha- kaalika- laghunaardeeya-harivamsa- vishnudharmotthara-kalki- mulgala- aadi- aathma-brahma- vishnudharma- narasimha- kriyaayoga- soorya-bruhadnaaradeeya- purushothama- bruhad Vishnu puraanaas.

### **ANALYSES OF SMRUTHIES:**

Smruthies are dharma sastra books which give the customs and rules to be followed. The book may explain some specific subject

as specialization in some cases and in some other cases, the smruthi books explain rules connected with many subject in an integrated way. Hence there are smurties written in many volumes and some smruthies are very small books. The smruties are updated with due corrections and amendments. The rules described in the smruthies vary depending upon the place and time, hence they are not universal truths and need not be practiced blindly.

The names of smruties: Smruthies are known in the name of following Rishies; Usana, Yajnavalkya, Vishnu, Manu, Aangeerasa, Yama, Athri, Samvartha, bruhad paraasara, Bruhathpati, Daksha, Saathaathapa, Likhitha, Vyaasa, Parasara, Sankha, Gouthama and Vasishta. Smruthies are also known as dharma sastra books.

### **ANALYSES OF DARSANAAS (VISIONS):**

There are six darsanaas in Hindu dharma propounded by six great sages. Highly philosophical matters are discussed in these books. In fact every subject under the Sun has been touched upon in these small books. One can understand the darsanaas, generally, only with the help of commentaries:

Jaminee's Poorva meemaamsa is the first darsana which explains the dharma and adharma and their merits/rewards and demerits/punishments.

Vedavyaasa's Uttaramaamsa: This darsana describes the power/energy/ universal soul known as Brahman which controls everything in the univers externally and internally. This is the basis of advaita darsana.

Kapila's saankhya darsana: Description on the composition of the universe is given as eight type of prakruthi including panchabhootha (five), intellect, mind and awareness/consciousness on the one side and the universal soul guiding and controlling all these within the system

Patanjali's yogasastra: detailed description of mind and body and the combination of panchabhootha (five) panchapraana, panchakarmendriya and pancha jnaanendriyas (five pranas, five sensory organs and five functional organs) is given in yoga.

Kanaada's vaiseshika: Here the specific description on the atoms by which the universe is composed of has been described. This darsana is specifically different from others in many ways, hence it is vaiseshika (special) darsana.

### **ANALYSES OF TWO EPICS:**

Ramayana and Mahabharata are the two epics. Generally, Hindus know about these epics. Hence a detailed description is not required for this branch of literature.

Analyses of Ramayana: The first Hindu epic known as aadi kaavya, written in 7 kaandaas (parts) having more than 550 chapters. Through the history, Sri. Rama Avathaara of Mahavishnu, the human qualities are explained here. The Ramayana written in Sanskrit has been translated to almost every Indian languages and important world languages. The messages of life are conveyed to the common people through Ramayana, story telling, dance, ka'hakali, dance, and so on through out India and Indian continent.

Analyses of Mahabharatha: It is the history of Pandavas who were meritorious noble brothers and Kourvaas who were opposite in qualities to pandavaas. The sufferings and pains of Pandavas and finally how Lord Krishna advised to fight for reestablishing the dharma has been explained in the Mahabharatha story. It is said Sage Vyaasa has told, hence everything in Mahabharatha, nothing else remain to be told vyaasocchishtam jagath sarvam

Thus in Hindu dharma the above books and their commentaries give the dharmic messages. None of these books is to be blindly followed or their messages to be blindly practiced. They are only the guiding books, one can walk from one level to a higher level, from there to a still higher and then to the highest level. Till one realizes that he is also the embodiment of the divine power. That is Hindu dharma.



## THE SCIENCE OF HINDU SPIRITUALITY

Hindu/sanaathana dharma has its foundation on scientific spirituality. Ancient Rishies are the authors of the Vedas, puranaas, itihaasaas and smruthies which are known as Hindu religious / spiritual books. Those rishies themselves wrote the books on economics – artha saastra-, music and dance – gaandharva Veda-, science of health and food – ayurveda-, civil engineering and sculpture – sthaapathya veda, etc which are the well known scientific books. In all the ancient Hindu literature one can see that science and spirituality are integrated. It is mentioned in the 40<sup>th</sup> chapter of the Yajurveda known as Eesaavaasya Upanishad that 'use the scientific knowledge for solving the problems in our life and use the spiritual knowledge for attaining immortality through philosophical outlook. *Avidyayaa mruthyum theerthwaa vidyayaa amruthamasnuthe*. A detailed description on the scientific and technological heritage of Hindu dharma has been separately given and hence it is not included in this text. Here only the science of spirituality is described for giving a clear understanding on the Hindu way of looking into the **different order/level** of spiritual science.

At all levels in other religions there exist only **one god/ divine power**. And that is the one and only one, without even a second on the pathway to attain that one. In Hindu dharma also there exists the ultimate one and only one god. But to attain that one, you can have different pathways and worship of different deities. For reaching New Delhi, the capital of India, there can be many pathways/ roads, but New Delhi remains the (same) one location. Some of these roads may be short cuts, some may be smooth and some other may not have street lights, etc. Thus the roads and nature of roads vary but the ultimate goal remains the same.

**The one Hindu god and its scientific explanation** : There exists only one god and it is reiterated throughout the Upanishads and Vedas. *Ekam sath vipraa: bahudaa vadanthi*. The ultimate

truth is one and only one, but some scholars may tell that it is many fold . *ekam eva na dvitheeyam*. The only one without the second. Further you can see the words of Rigveda: *dyaavaa pruthvi janayan deva eka*: the god, who created the celestial bodies and this earth, is one and only one. *Eka eva hi bhoothaatmaa bhoothe bhoothe vyavasthithaa ekathaa bhahudaa chaiva drusyathe jala chandravath*. The ultimate divine power is one and only one which is existing in each and every living being. It may be said by some as one and some others may say it as many, but the truth is like this; there is only one moon and it is reflected in different waters ( of river, well, a cup of water, sea or ocean). Just like the reflection of the one moon is seen in all, the same divine power is manifested in all living being. Even the whole philosophy of the advaita is based on the non duality of the divine power ( a-dvaita – the one without a second)

**The name of 'that one' in Hindu dharma is Brahman or Brahman.** Hindus do have different levels of *upaasana*/ worship. But the ultimate point where all the pathways arrive at is this point of Brahman ( do not pronounce Braahman). The Vedas say *Brahma sathyam jagath mithya*. The ultimate essence of everything is this Brahman and everything in the universe is the manifestation of that ultimate truth (which is the Brahman). *Jeevo Brahmaiva na aparaa*: Even the life force / soul itself is the same Brahman and nothing else. The Brahman is present in everything, in the smaller than the smallest ( in atoms) and bigger than the biggest (in the universe) and also present as the *jeevaathma* in all living beings: *Anoraneeyaan mahato maheeyaan aatma guhaayaam nihithosya jantho*: says Mahanaraayana Upanishad. One can see pure science in this explanation: The revolution of electrons and the spinning of the nuclei in atoms, the rotation and revolution of earth, the solar system, the galaxy , and so on are all guided from within the system and this force which gives the energy and guidance for their movement is known as Brahman. It is this same energy manifested as *jeevaathma* in the living being which controls the heart, lungs, the liver, the

blood circulation, the sensory organs, the functional organs, etc. in animals. In the *mahaasankalapa*, it is thus explained *achinthyayaa aparimithayaa sakthyaa briyamaanasya aneka koti brahmandaanaam madhye*; the billions and billions of galaxies which are revolving/ rotating under the torrential force which is beyond the level of imagination and limitless ... this force is from within the system and it is the one which guides the rotation and revolution. Hence the ancient Indian Rishies said that Brahman is the ultimate force/energy. Upanishad says that the Brahman is the one which can not be seen through eyes, heard by ears, analyzed by mind but the energy which is responsible for the proper functioning of the eyes, ears and mind.... Is Brahman. *yath chakshushaa na pasyathi yena chakshoomshi pasyathi....., yath srothrena na sruthi yena srothra mitham srutham....., yath manasaa na manuthe yenaahur manomatham..... thadeva Brahmathwam viddhi yadidam na idam upaasathe.* is the Brahman and worship that Brahman. In other Upanishads it is explained that the fire and air (*prathyaksham Brahma*), the sound (*sabda Brahma*), the Sun, the light (*chaakshu Brahma*), and so on are all the manifestation of this Brahman. This gives a clear definition for Brahman that it is the energy and manifestation of a power

Brahman is also present as *jeevathma*/ soul in me hence I say *aham Brahma asmi* ( I am the divine power) It is present in you hence *thath thwam asi* ( you are also the same divine power) It is present as life force hence *ayam athma Brahma* (this life force/ energy is the Brahman) and it is manifested as the **inherent intrinsic consciousness and awareness**, hence *prajnaanam Brahma* (that glorious knowledge is Brahman). These four sets of words corresponds to *Yajurveda*, *Saama veda*, *Atharvaveda* and *Rigveda* respectively, are known as four *Mahaavaakyaas*). The yogi who could get the experience of the realization of the *Brhaman* is known as *Brahma jnaani* and the process of realization is known as *Brahma saakshaathkaaram*. That state of *Brahma jnaani* is also known as *kaivalya state*, the state in which one



knows that only **one** is existing (*kevalam* means only one). *Aksharam Brahma paramam* means the Brahman is non destructible for ever. *Brahmakshra samudhbhavam* Brahman arose from the non destructible. There are few vedic and *puranic* words connected with Brahman, they are *Brahmaandam* ( the universal egg – a state before the big bang) Lord Brahma ( the creator of this universe and everything present here from energy) *Brahma vaivartham* ( the manipulation and manifestation of the universal force/ energy).... Now the word *Brahman* may be clearly defined based on the above explanations using modern science as follows: **the intrinsic, inherent, self guiding, self motivating, self awareness and self conscious present from each and every atom to the universe itself, is the Brahman, the ultimate god of Hindu!**

It is said that there are two states of *Brahman* . The extremely active state in observation known as *saguna Brahman* and the inactive state in observation known as *nirguna Brahman*. These two states are complimentary and never contradictory (as few scholars may say). (*saguna and nirguna* may be opposite words just like lower and upper are opposite words. But lower primary and upper primary are not opposites, they are complimentary). In an atom, the electrons are revolving at a fantastic speed/ velocity (*sagunathwam*) but the materials which are composed by the atoms are seen in *nirguna* state ( without rotating and spinning). The earth rotates and revolves at high speed (*saguna* state) but the people living on the globe earth do not feel the speed (*nirguna* state in observation). Our heart/liver/ lungs/ each and every tissue functions / works for all the 24 hrs ( in *saguna* state), but the body does not feel that (particularly when sleeping) such a series of biochemical processes are going on inside (*nirguna* state). Thus there are observationally two states for the Brahman one *saguna* state and other *nirguna* state. Sometimes *saguna upaasana*/ worship also means the worship in forms and images and *nirguna upaasana*/ worship means worship without keeping the images.



From the upanishadic explanation that the universe is filled with the *Brahma chaithanyam* ( the intrinsic... awareness and consciousness) it may be difficult for for a common man to understand this concept. For the understanding at a lower level and for giving a better perception for common man, the Brahman has been symbolically presented as a personified form of *prapancha purusha* or *viswa roopa* ( *prapancha* – univers; *purusha* – human form *viswa* – univers, *roopa* – size and shape) . This is a concept and symbolically presented, hence it is well defined as *prapancha purusha sankalpa* ( *sankalpa* – concept). It is narrated as *viswaakaram gagana sadrusam megha varnam...* having the size and shape of the universe, similar in area to the sky itself and colour that of clouds.... It is described in Vedas as *viswathaschakshurutha vishwatho mukho viswatho baahurutha viswathaspaath...* its face, brain, hands and legs have spread over the universe and everything in the universe works under his guidance and control. Bhagavath geetha gives the power of *viswa roopam* like *divi soorya sahasrasya bhaveth yuga pathutthithaa...*it looks as though thousands of Suns are blazing. The size of the *prapancha purusha* has been explained *na antham na madhyam na punasthavaadim* : there are no beginning, middle and end for that *viswa roopa*. Lord Krishna himself tells in Bhagavath geetha for seeing the universal person/ *viswa roopa*, one needs the divine eyes ( *divya chakshu*). Vedas describe it through *purusha sooktha*.

This *viswa roopa* / *prapancha purusha* is known in *puranas* and other literature (some times in Vedas too) as *Mahavishnu* / *Vishnu* and *Naraayana*. *Puranas* give detailed narration for *Naraayana*

At further lower level there exists a trinity concept in Hindu dharma. The trinity concept of Hindus is different from that of other religions. Here the 'controllers' of birth, existence / growth and death are symbolically presented in human forms as *Brahma Vishnu Maheswara – trimoorthy sankalpa* in which the universal laws of life cycle are symbolically presented . Mahavishnu is the base for the trinity concept.

**Explanation for Mahavishnu:** The blue colour of Vishnu denotes the colour of the sky and ocean which means the infinity/ limitless. The serpent on which Vishnu is lying denotes the coiled structure of galaxy. The name of the serpent *anantha* means limitless (infinity) the *ksheera saagaram* (ocean of milk) on which Vishnu is pictured shows milky way galaxy. *Anantha sayana* represent the silent universe/ galaxies. Symbolically Mahalakshmi ( meaning of this word is prosperity) has been attributed the position of the wife of Mahavishnu showing that any system can smoothly exist only with prosperity.

From Mahavishnu comes out through a Lotus (symbolically) the creator Lord Brahma. This symbolically presents a connection of Lord Brahma with the *prapancha purhsa* similar to the connection of the baby in the womb of the mother. The baby takes the energy and nutrition for growing/ cell production from the mother. Similarly Lord Brahma takes energy and material from for creation in the world. The four heads of Lord Brahma represent the four axes required for any creation: x, y, z and time axes. The Vedas (the word itself means knowledge) in the hands of Lord Brahma and the position of Saraswathy (deity of knowledge) as the wife of the creator symbolically present that for every creation knowledge/ vidya is required. The knowledge and creation (knowledge for creation) are inseparable components.

Lord Siva is the deity symbolically presents the controller of death/ destruction (the destruction is for further construction). Mahavishnu and Lord Siva are said to be connected through hearts ( which only means inseparable) *Vishnoasya hrudayam siva: Sivosya hrudayam vishno* – says Upanishads and Yajurveda. Symbolically Lord Siva has powerful fire in the third eye, powerful water and torrential air symbolically tied in the tuft and the snake around the neck ( symbol of international medical association) and thri sool in hand. All the five respectively present destruction through fire, water (flood , etc) air ( cyclone/ tempest, etc) diseases and using weapons. Parvathy (means

energy/force/sakti) is symbolically presented as the wife of Lord Siva . Through this combination of Lord Siva and Parvathy, it is shown that the destruction for construction can take place with powerful application of any one or more of the above five. (powerful fire, air, water, diseases and weapon only have the destruction capacity). Thus they become inseparable hence the concept of *Ardhanaareeswara* comes up. In fact the *Brahma Vishnu Maheswara sankalpa* and the *Lakshmi Parvathy Sarswathi sankalpa* are the symbolic presentation of the life cycle at spiritual- social and physical level when scientifically explained. Always the Hindus consider the knowledge, prosperity and sakthi/power in feminine gender. These explanations (of the gods) are the connecting layers of Vedic and puranic concepts of gods.

Further going at common mans level, the above six deities can be seen in different roles of puranic stories to convey the message of what they represent symbolically in. However these stories are mainly for conveying the values and universal truths in our life. And they are meant for the understanding for less educated common man who may not be in a position to understand the Brahman or *prapancha purusha* concept, or the symbolic message of Hindu trinity concept, etc.

About other deities: In puranas one can read the stories of *Vigneswara* having the shape of the cross section of human brain, worshipped as the Lord who removes/ protects from the hurdles in the life. Hurdles can be as huge as elephants and it can come from anywhere just like a rat (*mooshika vaahana*) comes. Students who learn the six branches of Vedic subjects *Siksha- nirukta- vyaakarana- chandassastra- kalpasastra and Jyothisha*, worship *Subrahmanya/ Muruka*, *Subrahmanya* is given the Lordship of six subjects. Hence six heads one for each subject. Incidentally, I feel it is worth explaining here that Ravana is said to have ten heads. It is because Ravana has the capacity of ten heads ( he has learned the four Vedas and six *Vedangas* and even he had tried to master the 11<sup>th</sup> subject, the *Ayurveda* too). *Yamadharma*



*raja* or *Kaala* is the controller of death *Yaama* and *Kaala* (*yaamasya apathyam pumaan yama:* and *kaalasya apathyam puman kaala*) both means the controller of time. Hence the names clearly give the scientific truth that the death is connected with the time. *Kaala* is symbolically presented coming on a he buffalo ( he buffalo is said to be the most senseless animal, hence the time of death arrives to us senselessly – and takes our breath-without looking the age, religion, sex or any other parameters of the individual– we say people die just like that)

Lord Krishna and Lord Rama and many heroes of the puranas and epics give us the message for elevating ourselves from the ordinary human level to the level of incarnation/ *avathara*. Their message enrich our life. They stand as role models in our life. Hence they are worshipped and celebrated as *avatharas*. In Hindu dharma none is a sinner. Hence everyone has the opportunity to elevate/ rise himself to the level of god. We say *krinvantho viswamaaryam*; (God will not get jealous of you if you are getting the level of god himself, in Hinduism). Let us convert the world into a great men's abode. Human being is considered as the children of immortal *..amruthasya putraa:* Every deity in Hindu dharma has a connected animal, bird, tree, flower, celestial body or planet (as *adhidevatha* or *pathyadhidevatha*), colour, metal, medicine, *manthra*, *gayathri*, letter, *dhyaana manthra*, *moola manthra*, ...etc. This gives an excellent message that these are to be protected. In Hindu dharma there are 33 crore (koti) *devaas* ! The meaning of this statement is very simple but wrongly understood. Koti means part (not ten million) and here 33 parts *devaas* (people with divine qualities) 33 parts *asuraas* ( people with demonic qualities) and 33 parts *maanavas* ( people with ordinary human qualities)– it is just like we say 1/3 of the human beings have divine, demonic and ordinary human qualities each. It is said that Hindus worship everything ! True in everything we can see the divine power and that divinity could be felt when we elevate ourselves into that level. Even a stone / wood / photo/ image becomes an idol *archakasya prabhavena sila bhavathi*



*sankara* ( by the proper method of worship by a priest/ devotee even a stone can be converted into Lord Siva /*Sankara/vigraha/* idol. *Archakasya aprabhavena siva bhavati sila*, by the improper outlook/ method of worship even the god itself will become a stone.

Hindus worship in temples. The temples are not merely prayer halls for Hindus, they are the quantum healing centers (*kshayaath thraaythe iti kshetra*). In temples the light, heat, sound and chemical energies are filled through lighting the lamp, camphor, keeping mirrors, etc. The sound energy through *manthra*, ringing of the bells, musical instruments, bhajans etc. The chemical energy is from bathies, aromatic flowers and leaves etc. Thus the temples are energization centres in Hindu way of worship. A devotee has to stand for few minutes in the temple environment in front of the *vigraha/* idol with *sareera* ( body) ,*mana* ( mind), *aahaara* (food), *vaak* (words/ talking ) and *karma* ( deeds) *suddhee* (purity) for energisation.

Hindus never allow the cremation or burial of human body in the temple premises Hindus always keep the idols or images having smiling faces (*Prasanna vadanam dhyayeth*- meditate on the god having smiling face). Hindus never place the sad/ crying faces or bleeding bodies for worship. The offerings of the gods, from the temple are taken as shared *prasadam*s not as body or blood of the gods. Hindus never pray for unloading/ transferring their sins to the god or representatives of god or saints. Using the concept, that the sins are transferable to someone who is a representative of god and punishing him for our sins is not existing in Hindu dharma. But Hindus pray for guiding through correct and dharmic pathway so that one can prevent committing the sins (*thamaso maa jyothirgmaya, ....etc*) Hindus never pray to god through intermediate saints, they submit directly their prayer. The people who fought for spreading the religion using swords and bloodshed and denigrated other religions are never elevated to the level of saints. The offering given to temples are not the bribes to gods but for pancha *yajna*- the offering for gods *Deva yajna*, *Rishi yajna* – for sages, *Pithru yajna* - for forefathers,

*bhootha yajna* - for all other living beings and *Manushya yajna* for feeding the poor people. The idol and temple are compared with human body (*idam sareeram kountheya kshetramithyabhidheeyate*) and human dwellings. Hence whatever are required for human body are performed through *thaanthric* way to the idols also. In olden days the temples were the capitals of the villages, through them the food supply, education, help for the society, legal consolation, counseling, marriages, etc were given/ performed. The priest hood of Hindu dharma and that of other religion are entirely different. The role of the priests was not political at all but to advise on dharmic and spiritual way. Hindus are never god fearing, they have only devotion to god not fear ( *daiva bhakti* and not *daiva bhaya*). There are five bhavas for the bhakti – *saantha bhaava*, *daasya bhaava*, *sakhya bhaava*, *vaalsalya bhaava* and *maadhurya bhava*. In all these the question of fear does not arise

Additional points to remember: Hindus worship the fire, air, the Sun, the celestial bodies, etc because they are all the parts of the *prapancha purusha*. The same reasoning is given for the worship of mountains, earth, rivers, etc. Hindus worship animals and plants and in fact every deity has a plant and animal associated with them, because all of them have *jeevaathma* / life force in it. Hence they are considered as divine in nature (*jeevaathma* is a part of *paramaathma*). The Vedic way of worship is through havans /offering through the fire. The puranic way of worship is the temples and idols and images. Every temple has a specific *vaastu* connected with it and that *vaastu* resembles the *yaaga saala*/ house of *yaagaas* and fire altars. Hindus say Vedas are holy because it gives absolutely (no stories ) the universal laws and truths. Anyone can learn Vedas and there did not exist a rule that people belonging to only one caste can learn Vedas. For keeping the seriousness and for strictly following the rules, the scholars defined that who has Brahminical qualities only can learn Vedas, which can be acquired and not obtained by birth alone. All the Rishies who composed Vedic *manthras* were not Brahmins, Sri Krishna or Sri Rama were not Brahmins. Many

ancient *Rishies* and many of those *Rishies* who are living even now are not Brahmins.

Hindus worship books/letters/ because it is the base for knowledge. Hindus worship the tools and instruments during *aayudha pooja*, by performing pooja once in an year because tools are the lively hood for human beings. Hindus have given the status of divine power to many phenomena like: the Sun, because it gives light and heat for all living beings; the air, because all living beings are surviving because of it; the water, because without which life is impossible; the earth, because it is where all the life is surviving (not only that they are all parts of *prapancha purusha*); our parents, because they gave birth for us and they are our creators; plants and trees, because they provide us food, and so on.

The Hindu way of life is different from that of the followers of other religions. Learning and practicing Hindu dharma should be done directly and it is an experience. All the Hindu way of life is through customs and rituals. It is always advised to follow the relevant and scientific customs and rituals which are beneficial psychologically, physiologically, family based relation and social relations strengthening and also for national integration. All this customs and rituals put together is known as *sanaathana dharma* hence it is said Hinduism is not a religion but a way of life. Hindu dharma get refined continuously by the *Rishies*, hence any superstition comes into the Hindu dharma, *Rishies* like Lord Budha, Jain, Sankara, Madhwa, ..... They refine and make it more powerful.....

Thus says Lord Krishna in Bhagavath Geetha: Whenever the dharma comes down and adharma takes an upper hand, the god himself will do the needful for the uplift of Hindu dharma. He will protect the nobles, punish the bad people and protect the dharma. Perhaps that is the reason why even after more than one thousand years of foreign invasion, massacre, destruction, plundering and looting by the foreigners, this dharma did not perish. It is fast spreading through out the world particularly in the



developed world. Let us all learn the basic principles and application of those from the Hindu dharma scientifically either for practicing it or for challenging it.

## SCIENTIFIC AND TECHNOLOGICAL HERITAGE OF HINDUS

This is only an outline on the scientific and technological heritage of Hindus to be selected for the study by the individuals depending on their own interest and specialization. They may collect as many points asking the questions why ? how ? when ? where ? what? and comparing the answer with the knowledge existing in other parts of the world, in each topic, so that they can learn thoroughly and teach others. Let us try to become an expert in selected and specialized areas of Indian scientific heritage. The syllabus are given Italian subject wise.

Example : If in the syllabus Ajantha Cave temple is given, ask the questions what are the novel points with Ajantha cave temple? when was it constructed ? how it was constructed ? what are the salient structural features of Ajantha? How the people in other parts of the world were living during when this Ajanta cave temples were constructed (BC 50) ? What was their capability in this subject area of cave structure construction ?.....Ask these questions and find out the answers. Repeat the same for other syllabus points.

### BIOLOGICAL SCIENCES

**Health science** (Health science is a part of ayurveda which is an upaveda of Atharva veda. It is also discussed in yoga sastra which is one among the six darsanas of the Hindus. The subject has also been dealt with in puranas and itihasas): The Indian vision on health is given by Maharshi Susrutha, Charaka and Vagbhatachaarya and many others. The approach taken by Patanjali in Yoga saastra, the spiritual approach of body and mind, etc will be the part of the Indian health science. Aswini devatha



concept of hitha aayaasa and mitha aahaara (food & exercise), need of appropriate exercise based on the age-sex-physiological conditions, etc. Yogaasanas, sooryanamaskaara, effect of medicines, identification of diseases through saastram pramaanam/ aaptavaakyam pramaanam/prathyksham pramaanam/ anumaanam pramanam / methods. Use of drugs, fastings and pathyas and fasting as a part of customs/rituals. Selection of foods based on climatic variation/age/health conditions/etc of the person/patient, physical and mental rest, upaasana and worship as a part of day to day life, ethics and morality in the common man's life and also for doctors, ... cause of illness, pathogenic organisms, precautions to be taken for good health, solar therapy, music therapy, Yoga therapy, Reiki, energy healing, water therapy, as described in the Indian system. The knowledge on surgery plastic surgery and surgical equipments known as sastras and yantras as described in Susrutha samhitha, practising surgery as given by Maharshi Susrutha. Variety of acharas/customs and rituals influencing the health. Importance of vegetarian foods. Indian traditional foods and their merits. Taking oil bath during selected days, hot/cold water bath. Allowing children to play in the soils after smearing the oil. 'Grandmaa's technological foods' and baby health care system' existed in ancient India.

**Mental Health / Psychology (this is a subject of ayurveda and yoga/ poorva meemamsa/uttaramameemamsa/vaisesika/ darsanas and Upanishads. It has been discussed in detail in Yogavasishta, Bhagavath geetha, dharma saastra and so on):** Description of mind given in Upanishads, mental influence on health, the influence of yamaas and niyamaas: ahimsa- satyam- astheyam-brahmacharya- aparigraham- soucham- santhosha- thapa- swadhyayam- eeswara pranidhaanam –etc. Effect of stabilised vision on life, controlling the anger, fear, and attachment, mental preparations to face ups and downs/loss and profit/ success and failures/ animosity and friendship/ appreciations and criticisms ...as described in Indian philosophical books. Influence of puranic / epic related stories in mind to face the realities of the life.

Influence of pranayam/ dhyaana/dharana etc on the mind. Impact of food on mind as proved by the modern science, effect of saatwic food, dreams, effect of manthras on mind, customs influencing the mental health and family relations. Analyses of the purpose of living, family-social-and national goals to be put forth for a purposeful life and its impact on mind. Spirituality and faith in healing. Effect of curative chemicals on mind and body. Bhajans /keerthans/ prayer/ manthras, etc on mind. The positive songs and images influencing the mind. Psychologically influencing acharas.

**Food science(very specific explanations are given in ayurveda- a part of atharvaveda, dharma saastra and gruhyasootra (part of kalpasaastra) and to some extent in puraanaas):** Variety of Indian foods, balanced nutritious foods, natural traditional baby foods, the medicinal components usually added in Indian foods (like asafoetida, turmeric, spices, mustard, etc), pathya based food during illness, specialized cooking, roasting, fermenting, processing, preserving, etc. done for variety of foods and their science. Generation of specific flavors in foods by suitably modifying spices. The science of altering the foods during fasting on specific days like ekaadasi/ somavaar vratha/ karthika month/ vaisaakha month/ etc. Opting for integrated balanced foods through fasting and vrathaas, importance of selecting cooking vessels like ceramics / iron/copper/ brass vessels ( for getting micro nutrients like, iron, zinc, copper, silica, magnesium, sodium, potassium etc), variety of vegetables and their significance in balanced healthy foods. Many more significant scientific observations can be made if a student carefully examines the Indian food, naturopathy and vegetarian food.

**Chemistry ( Rasachikitsa is a part of ayurveda prevalent in north India. All the authors of Rasachikitsa were Siddhas or Maharshies. The chemistry descriptions, are given sytematically in the rasa books) :** The ancient Indian chemistry books like rasarnava, rasaratna samucchaya, rasendra choodamany, rasarnavakalpa, rasa chandrika, rasaratnakara, and hundreds of

rasa based books . (These books are available in Sanskrit with English or Hindi translations.). The knowledge on chemicals, particularly in inorganic chemicals like sulphides/ sulphates/ oxides/ etc. Sanskrit names of chemicals, detailed description given for setting up a laboratory, scientific temper, qualification of laboratory assistants, research scholars as described in Rasaratna samucchaya, properties of inorganic chemicals and their used described by Vagbhatacharya, centuries ago. Chemicals used for various purposes as described by Bharadvaja in yantra sarvaswa, Varahamihira in Bruhath samhita and also by others in the above chemistry books .

**Bio-pesticides( biopesticides are part of vrukshayurveda which again is a part of Ayurveda or Bhruhat samhitha):** Variety of plant products, neem, sweet neem, neem cake, mustard cake, tulasi, clove, pepper, turmeric, tobacco, oils from sesame , cotton seed, castor etc., used as bio pesticides and as preservatives. Traditional methods of pest control like fumigation with neem/ sulphur/ camphor/ coconut husk (since it contains sulphur /coconut shell (raw- for its phenolic content) / cow dung (since it contains ammonia). The use of panchagavya / aqueous cow dung filtrate /extract as pesticides. The traditional knowledge available from farmers. Detailed descriptions for controlling the pests/microorganisms/etc given in Vruksha ayurvedic books.

**Plant drugs/pharmacology ( this is also a part of the atharvavedic ayurveda):** Active plant bio-chemicals possessing medicinal properties, as described in Charaka samhita, Ashtanga hrudaya, ashtanga sangraha, sahasrayoga, etc. comparative studies on modern and traditional knowledge of medicinal plants. The student can try to understand as many plants as possible which are good sources of the bio-active principles. Variety of plants ( herbs, shrubs, creepers, grass, trees, etc.) used for curing diseases. The plant leaves, buds, flowers, stems, roots, latex, etc. used for treating specific diseases. Single drug treatment.

**Medicines and medicinal preparations /plant biochemistry ( Charaka samhitha and Susrutha samhitha are written by**



**Rishies having the caliber of those of vedic Rishies.** This also include the name of sages like Chyavana/Brugu/Vagbhata/Agastya and so on): The descriptions of inorganic chemicals used as medicines in ancient Indian Rasa chikitsa books, their preparations/processing and preservation. The plant products used as drugs, the raw drugs, their harvesting, drying, storage, mixing, drug formulation, decoction preparation, etc. Variety of Ayurvedic drug formulation obtained by mixing many raw drugs. Knowledge on the possible chemical changes taking place in ayurvedic drug preparation while drying, storing, heating, roasting, boiling with water, concentration, etc (all ayurvedic preparations). Here we have to focus only on the knowledge existed and their scientific merits, in the area of plant drugs. The scientific knowledge behind kashaya/decoction preparation, choorna, kwatha, lehya, arishta, ghrutha, thyla. etc Preparations and their basic principles applications.

**Basic plant sciences/botany:** Detailed description given in Vrukshayurveda by Rishies like Saarnagadhara, Katyayana, Varahamihira, Parasara, and others. Plant growth, grafting, irrigation, use of manure, seeds preservation, phototropism, agricultural practices both basic and applied. Seasons of sowing/ planting/ biodynamics of agricultural practice, etc., Variety of the traditional knowledge still practised in villages, in the production of agriculture commodities.

**Fermentation technology.** The knowledge of microorganisms existed in India as described in ayurvedic books. Fermentation of milk to curd and yoghurt, fruit juice fermentation to vines, medicinal preparation of arishtas, etc. Fermentation procedures followed in four major types liquors mentioned in Chanakya's Artha saastra ( Arthasastra is an upaveda of Rigveda), the source of microorganisms, cultures, fermentation products mentioned in the ayurvedic and vrukshayurvedic books. Fermented rice based common solid foods like pan cake, fermentation of traditional liquors from coconut and palm products are the examples.



## TECHNOLOGICAL SCIENCES

**Ancient Indian mines:** Knowledge on the ancient Indian mines which were active during the last three or more millenia, the ores/ minerals of copper, gold, zinc, lead, silver, distributed through out Rajasthan, Haryana, Bihar, Bengal, Gujarath , Karnataka, Uttar Pradesh, Madhya Pradesh, etc.... The technology adopted for digging mining, transportation, processing and refining the above ore prior to metallurgical processing, provisions given for aeration and lighting in mines, the present day scenes of ancient metallurgical sites.

**Ancient Indian knowledge in Metallurgy (metallurgy is a part of lohathanthra which again is becoming a part of Rasachikitsa/saastra):** The production and purification of metals, the use of flux and slag, temperature attained, technology for the production and purification of metals like tin, copper, iron, silver, gold, zinc and lead. An understanding of the chemical reactions accomplished like, oxidation, reduction, slag formation, distillation of low boiling metals, etc. The fine technology used for the large scale production of bronze, brass, panchaloha, bell metal, coin making metals and many alloys as mentioned in chemistry books and also in the books like Chanakya's Arthasastra. Impressive metallic alloy preparation techniques mentioned in the Rasa books like Rasopanishad and Bharadvaja's writings. The kilns and mooshas used for the metallurgical applications. Special methods adopted for the preparation of zinc and lead. Preparation of the purest form of copper and alpha and beta brass. Identification of alpha and beta tin and descriptions of the physical characteristics of these metals. The metal ingots, sheets, plates etc of zinc/lead/iron/brass/bronze/copper/gold/silver/...of ancient Indian origin excavated from other countries like Athens, Babylonia, Rome, Egypt,...

**Ancient Indian Iron making technology.** Production of pig iron, cast iron and wrought iron, Delhi and Dhar iron pillar, forge welding, lamination, paint coating for preventing the rusting, etc.

Making the swords, the Banaras and Kodumanal swords, carburization in iron instruments used in agriculture and surgery. Rust free preservation techniques adopted for iron, woortz steel. Large scale production of iron alloys, export of iron to European/ middle east countries. The iron technology existed in North Kerala/ Andra/Nasik/ Gujarath/Bengal/Varanasi/etc. the Damascus sword from India.

**Ceramics science and technology in ancient India (detailed description of the moosha as given in Rasa based books) :** The top quality ceramics vessels, tiles, glazed vessels, beads, bricks etc. produced in Harappa, Mohanjo daro, Lothal, Varanasi, Thakshasila, Kalibhangan, Hastinapura, and many other North and south Indian archeological sites. Variety of coloring materials used for the ceramics vessels and decoration ceramics articles which were also used in the glass making. The ceremics floor of great bath of Mohen jo dara, the lost city of Cambay, Dwaraka, Hastinapura, etc

**Industrial and instrumental glass technology existed in India:** Variety of multi colored glasses with different size, shape, appearance and capacity produced in India . The glass beads, ornaments, plates, vessels, made using variety of inorganic coloring materials like the oxides, carbonates, sulfates, phosphates, etc of chromium, lead, copper, iron , nickel, calcium, sodium. The non metallic compounds used as coloring materials. Technology for introducing the golden/ silver leaf/plates in glasses.

**General Instruments used in ancient India:** Description of a variety of instruments given in Bharadvaja's yantra sarvaswa (Bharadvaja is now a clan ordered after the great Vedic sage of Bharadvaja . He is known as Maharshi Bharadvaja. Only a part of his book Yantra sarvaswa/ amsubhodini is now available) the Vaimanika saastra, dvaantha pramapaka yantra, etc. The numbering systems with serial numbers of the components of instruments, alloy preparations, quality of glass lenses, prisms, glass plates, variety of Krithaka loha, ( artificial metallic alloys having non

metallic compounds also) dies used for molding the instrument parts/components, in required size and shape. The instruments used in astronomical calculations known under the title jyothir yantra .

**Musical instruments** ( Music is Gandharva veda which is an upaveda of Saamaveda. Music/ dance/ drama/ musical instrument are all originated from Saamagaana) : Variety of string instruments for music/dance performances, the metallic alloys used for the preparation of strings, wind instruments, the knowledge of sound waves , the membrane instruments, preparation/processing of the membranes for these musical instruments. The basic knowledge of sound in music. The granite music pillars known as sangeetha mandapa seen in ancient south Indian temples. Traditional Indian musical instruments like flute, idakka, mrudanga, chenda, thaala, naadaswara, veena, violin, harmonium, and so on. The basic principles adopted in their making and use.

**Surgical instruments** ( detailed description of these instruments and their pictures are given in the book written by Maharshi Susrutha as a part of Salya chikitsa which is a part of ayurveda/ upaveda of atharva veda): The surgical instruments known as sastras and yantras numbering more than a hundred, as mentioned in Susrutha samhitha, the metals used for making these instruments, their size, shape and comparison with the modern instruments used for the purpose. Description of plastic surgery techniques. The instruments used for kidney stone removal, stitching, cutting open, etc. all these instruments used in the modern surgery may be compared with those available in India thousands of years ago.

**Laboratory equipments** ( this descrtiption is coming as part of rasa books): More than 35 types of ceramics, glass and metallic equipments are mentioned in Rasaratna samucchaya for the use in chemical laboratories for the processes like, distillation, sublimation, extraction, drying, heating, roasting, mixing, decanting, etc. They are generally known under the name yantras



made using specific quality clays. Many varieties of mooshaas, putas yantras were also used here for processing the metals and other compounds.

**Kilns/furnaces, mushas & putas** used for metalurgy. Variety of furnaces and kilns, crucibles were used for the production of various metals and alloys. The high temperature attained for oxidation, reduction, slag preparation and distillation of variety of metals and correspondingly suitable selection of putas/furnaces. Heating materials and their proportions, heating time, flux used for removing the impurities in the metal processing, description of maha gajaputa, gajaputa, kukkuta puta, kapotha puta .....etc and their preparations.

**Painting Technology/organic and inorganic colorants** ( this subject is coming as part of sthaapathya veda /architecture which is an upaveda of Rigveda. Sometimes it is also said as the upaveda of Atharva veda) . The chemistry of the paints used in Ajantha, Ellora and other cave temple paintings, mural paintings, the inorganic colors and organic plant products for paintings, their preparation, mixing, applying on the preprocessed surfaces. Selecting and processing plant products used as paints. The preparation of inks, for variety of applications. Mural paintings, oil paintings, preparation of painting beds/ walls/ canvass, etc as done in cave temples and walls.

**Textiles technology** (detailed description can be seen in dharma saastra and artha saastra which are part of either kalpasastra or upaveda): Ancient Indian textile industry as mentioned in Chanakya's Artha saastra, textiles produced using cotton, silk, wool, jute, and also incorporation of gold, silver and lead metallic threads as borders for the textiles. The famous Kancheepuram, Banaras,... sarees/textiles. the dying technology and coloring materials used. The textile dyes, leather colors, variety of coloring materials produced in different parts of India and method of application of the dyes.

**Civil engineering and architecture** ( The subject matter is dealt with systematically in Sthapathya veda which is upaveda – as mentioned above. Detailed description is also available in



**artha sasstra books) :** The civil engineering skill demonstrated in the famous south Indian temples constructed by the kings of the Chola, Chera, Pandya, Hoysaalsa, Kakateeya, Vijaya nagara ...periods. The huge and tall entrances/gopurams of these temples. The mortars/cements used for the construction of these temples. The instruments used for measuring / maintaining the geometry of these structures. The granite/ marble/ laterite stone cutting and polishing equipment/devises existed during then. The transportation techniques adopted for the huge granite pieces. Construction of marble temples, palaces and lake palaces in Rajasthan . The temples of Kancheepuram, Rameswaram, Chidambaram, Kumbhakonam, Thiruvannamali, Sucheendram, Trivandrum, Konark, Khajuraho,.... The music pillars and music mandapas, the knowledge on the sound waves produced by these granite pillars and granite stone carvings. The carving work undertaken with top precision, in all the above structures.

The construction of cave temples of Ajanta, Ellora, Elephanta, knowledge on geological aspects of rocks in which the Chaityaas and Viharas were carved out. Huge palaces constructed particularly like Jaisalmar palace, palaces in the pink city of Rajasthan, Gwalior, Mysore, Hyderabad, etc. The air conditioning/ temperature maintaining mechanisms adopted, glazed and non glazed tiles/glasses used for flooring/windows. The ponds and water reservoirs made thousands of years ago. (look into as many structures constructed as possible and their technologies)

The civil engineering sciences and technologies of forts and walls, channels, rivers, etc. the archeologically important sites of Mohan jo daro, Lothal, Harappa, Dwaraka, the lost city of Cambay etc

### **BASIC SCIENCES:**

**Basic principles of physics (for these basic principles one has to search many books; examples are sited against each subject)** the velocity of light ( Sayana Bhashya for Vedas), wave nature of sound (Maharshi Gouthama's nyaaya saastra), seven colors of light (Rigveda), Heisenberg's uncertainty principles Patanjali's yoga sastra), definition and explanation of atoms,

gravitational forces (siddhanta siromany of Bhaskaracharya II), different types of rays (UV, IR, Heat rays, visible rays - as explained by Bharadvaja) lenses, prisms, magnetic materials like iron and variety of magnets. Time, weights and other measurements, linear parameters. Modern scientific principles and their equivalent ancient observations. Explanations given in yantra sarvaswa of Bharadvaja, the vaimanika saastra, dwanthapramapaka yantra/ spectro photometer, etc the scale used in measuring the temperature, the serialization of instrument parts commonly used., graduation method adopted, metallic alloys used in measuring the light waves, etc (all from yantra sarvaswa of Maharshi Bhardvaja)

**Ancient Indian Mathematics & Astronomy** (Mathematics and astronomy are the fifth vedanga of vedic literature kown as Jyothisha. There are four vedanga jyothisha connected with Rigveda- archa jyothisha, Yajurveda – Yajusha jyothisha, Samaveda samajyothisha and Atharva veda - Atharvana jyothisha). The later development of th subject matter are directly connected with these jyothisha books) : Detailed explanations are given in the books written by Aryabhatta (I & II), Bhaskara (I & II), Vateswara, Manjula, Lalla, Varahamihira, Parameswara, Sankaranarayana, and many other mathematicians. The four number systems, (Sanskrit number, Aryabhatta number, Bhootha sankya and Katapayaadi number) arithmetic and geometrical progressions and their variety of applications, interest calculations, moving bodies, forward and backward motions, linear and angular measurements, number theories, square/cube roots and power series, determinations, degree/minutes/seconds/microseconds both for time and angular measurements, various geometrical figures both inscribed one another and independent figures, parameters connected with area, perimeter, volume of squares, triangles, circles, trapeziums, spheres, cones, cyclic quadrilaterals, polygonals, detailed algebra, quadratic equations, monomial and binomial theorems, etc. Hundreds of theorems developed by Aryabhatta, Bhaskara I & II, Sankaranarayana,

Sangamagrama Madhavacharya, Puthumana Somayaji, Vateswara, Aryabhatta II, Sankara Varman, Parameswaracharya..... the application of ka ta pa ya adi number and bhootha sankhya systems made by the above mathematicians.

Determination of Sine, cosine and tangent, Rsine values their squares, square roots, additions and subtractions, determination of angles at degree/minute/second levels. and their tables, as explained in detail by Varahmihira/ Vateswara/ Aryabhata II/ Puthumana Somayaji/ Parameswaracharya/ Nilakanta/ Sankaranarayana/ Achuta/ jayadeva/ Manyulacharya/ and so on, method of determining these values, angles in degrees and radians, calculations and theorems connected with these values. Relation among radius- arc-chord-circumference - sine - cosine - tangent - angles. Indian theorems known in foreign scientists names such as : Newton's theorems, Gregory's theorems, Kelvin's theorem, Lhulers theorem, Lebnitzs' series, Taylor series, Tycho Brahe equations, etc.

**Astronomical parameters( As mentioned above; Jyothisastra is applied ganithasaatra according to the fifth vedanga known as jyothisha):** Various astronomical and geographical parameters mentioned in the above books: The spherical shape, size, diameter, circumference, gravity, declination, rotation speed, revolution, celestial/terrestrial latitude and longitude, parallax in latitude and longitude, earthsine, etc of earth. Many more astronomical parameters described with definition by Vateswaracharya, like co-latitude, prime meridian, and its relation with time. Sun rise and sun set, eight type of revolutions of planets, visibility of planets, declination, precision equinox, alpha Aeries point, apogee, perigee, solar and lunar eclipse, calculation of eclipse, diameter of shadow and movement of shadow, instruments used for time calculation and also for the calculation of various astronomical parameters known as yantras.

Hundreds of parameters described systematically and calculated mathematically on solar and lunar eclipses, changes in the signs of latitude/ longitude, time variations, east -west lines, avanti lines of international importance, the inferior planets and superior



planets, occulting of planets and stars, the star constellations, the comets, and their appearance, etc., etc

**Indian Management science ( All Indian management books are directly connected with Itihasa( epics) puranas, and subhashitas):** Thousands of model and relevant management principles are explained by Chanakya in (Chanakya) neetisara also known as Chanakya upadesa, Bharthru Hari in upadesa sathaka in hundred points, Vidura in Vidura neetisara as a question answer method of presentation between Dhrutharashtra and Vidura, Bhishma in Bhishmopadesa to the questions asked by Dharma putra,, and also books like Yoga Vaasishta as given by Mahrshi Vasishta, Bhagavath geetha advise given to Arjuna by Lord Krishna, Sukra neeti sara by Sukra muni and many subhashitaas ( advises) mentioned in Pancha thantra, Ramayana, Mahabharata, Thirukkural and so on. They are all applicable even for the management even in the 21<sup>st</sup> century.

**Ancient Indian knowledge in Economics (This subject is the upaveda of Rigveda):** The book on artha saastra written by Chanakya, known as Koutileeyam with many cross references books of dharma sastras/ smruthies dealing with this subject The detailed explanations about money, budget, banking, interest, loans, compound interest, penal interest, surety, witness, document preparations for loans, pledging of materials, leasing, etc. Detailed method of implementing sales tax, agricultural tax, property tax, gift tax, land tax, house tax, customs duty and penal taxes, etc. ( as described in dharma saastra) can be seen in many dharmasastra books written during BC 500 and before.

**Indian Philosophy (Philosophies are part of Upanishads which are known as vedantas or part of shaddarsanas:** The philosophical compilations known as darsanas by Vyasa, Jaiminee, Patanjali, Gouthama, Kapila and Kanaada are - poorva & utara meemamsa, yoga, nyaaya, vaiseshikaa, and sankhya are the most important books known as shad darsanas. Many fundamental principles of physics, chemistry, biology, etc are mentioned in the above darsanaas. Sankara's Adwaita and Madhva's dwaitha, The book of Charvaka known as Charvaka samhita of atheism,



etc. Other than the specific philosophical compilations, the philosophies are described in upanishads, Bhagavath geetha, Yogavasishta, etc.

Thus the knowledge of Hindus did not restrict mere rely on spirituality and achaaras but also focused on every branch of modern science and technology. That is the reason why the western scientists are patenting many of these knowledge now.

### QUOTATION FROM INDIAN SCIENTIFIC HERITAGE - MATHEMATICS & ASTRONOMY

#### DISCOVERY AND USE OF ZERO:

गायत्रे षड्संख्यामर्धेऽपनीते द्वयङ्के अवशिष्ट स्रयस्तेषु रूपमपनीय द्वयङ्काद्यः शुन्यं स्थाप्यम् ।। - In gayatri chandas, one pada has six letters. When this number is made half, it becomes three (i.e the pada can be divided into two). Remove one from three and make it half to get one. Remove one from it, thus gets the zero (Soonya). -

PINGALACHARYA IN CHANDA SASTRA 200 B.C.

#### CALCULATIONS WITH ZERO :

विकारामायान्ति घनक्रणखानि न शून्य संयोग वियोगतस्तु शून्याद्धि शुद्धं स्वमृणं क्षयं स्वं वधादिना खं खहरं विभक्ताः - Nothing happens (to the number) when a positive or negative number is added with 0. When +ve and -ve numbers are subtracted from 0, the +ve number becomes negative and -ve number becomes +ve. When multiplied with 0, the values of both +ve and -ve numbers become 0, when divided by 0, it becomes infinity (khahara). - SRIPATI IN SIDDHANTHA SEKHARA 1039 AD.

DISCOVERY OF PLACE VALUES - I : यथा एकरेखा शतस्थाने शतं दशस्थाने दशैवं चैकस्थाने यथा च एकत्वेऽपि स्त्री-माता च उच्यते दुहिता स्वसा च इति - In the unit place the digit has the same value, in 10th place, 10 times the value and in 100th place 100 times the value, is given. - VYASA BHASHAYA TO YOGA SUTRA 650 AD

DISCOVERY OF PLACE VALUES - II : यथाचैकापि रेखा स्थानान्यत्वेन निविशमानैक दश शत सहस्रादि शब्द प्रत्यय भेदमनुभवति

One and the same numerical sign when occupying different places is conceived as measuring 1, 10, 100, 1000 etc. - SANKARACHARYA VEDANTA SUTRA BHASHAYA (700 AD)

**KNOWLEDGE ON INFINITY :** अस्मिन् विकारः खहरे न राशावपि प्रवेष्टेष्वपि निःसृतेषु बहुष्वपि स्याल्लयसृष्टिकाले नन्ते च्युते भूतगणेषु यद्धत् - Nothing happens to the (huge number) infinity, when any number enters (added) or leaves (subtrated) the infinity. During pralaya many things get dissolved in Mahavishnu and after pralaya, during srushti all those things get out of him. This happens without affecting the lord himself. Like that, whatever number is added to infinity or whatever is subtracted from it, the infinity remains unchanged. - BRAHMAGUPTHA IN BRAHMASPHUTA SIDDHANTA 600 AD & BHASKARACHARYA II - BEEJAGANITA 1148 AD

**USE OF AVERAGE VALUES :** गणयित्वा विस्तारं बहुषुस्थानेषु तद्युतिर्भाज्य स्थानकमित्या सममितिरेवं दैर्घ्यं च वेधे च - (For length, breadth and depth) the measurements should be taken at many places and the sum should be divided by the number of times (places) the measurement is taken. - BHASKARACHARYA II IN LILAVATI 1150 AD

**USE OF FRACTIONS :** द्रम्माधीत्रिलवद्वयस्य सुमते पादत्रयं यद्भवेत् तत् पञ्चांशक षोडशौशचरणः संप्रार्थितेनार्थिना । दत्तो येन वराटकाः कति कदर्येणार्पितास्तेन मे ब्रूहि त्वं यदि वेत्सि वत्स गणितं जार्तिं प्रभगाभिधाम् ।। - One man has given to a beggar fraction of 1 dramma (a unit of money). That fraction is one fourth of the one sixth of one fifth of the three fourth of the two third of the half of a dramma. Then tell how much kowdi (a unit fraction of the amount dramma) was given to the beggar?

**USE OF RATIO AND PROPORTION :** अष्टौ दान्तास्त्रयो दम्या इति गावः प्रकीर्तिताः । एकाग्रस्य सहस्रस्य कति दान्ताः कतीतरे ।। - (Out of 11 cattle) Eight are tamed and 3 are to be tamed and (how many are) to be tamed) if the number of cows is 1001? - BHASKARACHARYA I - ARYABHATEEYA BHASHAYA 628 AD

**PERMUTATIONS AND COMBINATION - I :** कटुकतिक्त कषायाम्ललवण मधुरैः सखे रसैः षड्भिः । विदधाति सूपकारो व्यञ्जनमाचक्ष्व कति भेदम् ।। - Friend, a cook prepared varieties of food with 6 savours: pungent, bitter, astringent, acid, saline and sweet. Say what is the possible number of

varieties of food that can be made with these savours. -  
SRIDHARACHARYA IN PATIGANITA 990 AD

PERMUTATIONS AND COMBINATION - II : पाशाङ्कुशाहि डमरुक कपाल शूलैः  
खड्वाङ्गशक्ति शरचापयुतैर्भवन्ति । अन्योन्य हस्त कलितैः कति मूर्तिभेदाः शंभोर्हरेरिव गदारि  
सरोज शंखचक्रैः ॥ - Pasa, ankusa, serpent, damaru, kapala, soola,  
khatvanga, sakti, chapa, sara with these (ten) items how many per-  
mutations and combinations are possible for Lord Siva. Similarly  
with the four items, sanku, chakra, gadha and padma holding in  
the hands, how many combinations are possible for Lord Vishnu?

- BHASKARACHARYA II IN LILAVATI 1114 AD

PARTNERSHIP AND SHARES : समवायकास्तु वणिजः पञ्चैकैकोत्तराधि मूलधनाः ।  
लाभः सहस्रसंख्यो वद कस्मै तत्र किं देयम् ॥ - Five partners collaborate in a  
business. The capital invested by them are (in the ratio) one and  
the same number increasing successively by one (i.e 1,2,3,4, & 5)  
respectively. Profit that accrued amounts to 1000. Say what should  
be given to whom. - BHASKARACHARYA I - IN ARYABHATEEYA BHASHYA 628 AD

LOANS AND INTERESTS : कुटुम्बार्थमशक्तेन गृहीतं व्याधितेन वा उपप्लावनिमित्तं च  
विद्यादापत्कृतं तत् । कन्यावैवाहिकं चैव प्रेतकार्येषु यत्कृतं एतत् सर्वं प्रदातव्यं कुटुम्बेन  
कृतं प्रभो ॥ - Loans are taken for meeting the expenditure connected  
with economic problems due to family burden, health problems,  
treatment, education, expenditure during accident, marriage of  
daughter, for performing rituals connected with the demise of the  
family members, etc. - VISHNUSMRUTHI 100 BC

INTEREST CALCULATION : मासेन शतस्य फलं पञ्चैको भाव्यकेर्धमय वृत्तो ।  
लेखकपादो वर्षे पञ्चाधिक नवशतीमिश्रम् ॥ - The rate of interest being 5%  
per month, the commission of surety 1% per month, fee for ac-  
countant 1/2% and charges of the scribe 1/4% per month, certain  
sum amounts to 905 a year. Find the capital, the interest and the  
shares of the surety? - SRIDHARACHARYA IN PATIGANITA 990 AD

RULES OF CHARGING INTEREST : अय उत्तमर्णः अधमर्णाघया दत्तमर्थं गृह्णीयात् ।  
द्विकं त्रिकं चतुष्कं पञ्चकं च शतं प्रतिमासं ॥ - The loans can be given and  
taken between borrower and lender. Generally charged interest rates  
are 2, 3, 4, or 5% per month. सपादपणा घम्या मासवृद्धिः । पणशतस्य पञ्चपणा  
व्यावहारिकी ..... - Reasonable (dharmic) rate of interest is 1.25% per



month (i.e 15% per annum) on the transactions with common man for non commercial purposes. But for commercial purposes (for making profit out of it) interest rate can be 5% per month. - VISHNU SMRUTHI 100 B.C

**RULES OF BODIES IN MOTION :** भक्ते विलोमविवरे गतियोगेनानुलोमविवरे द्वौ ।  
गत्यन्तरेण लब्धौ द्वियोगकालावतीतैष्यौ ।।

Whenever two bodies are travelling in the opposite directions, the distance between them is to be divided by the sum of their speeds. If they move in the same direction, the distance is to be divided by the difference of their speeds. This gives the time required for meeting of the bodies or the time elapsed after meeting of the moving bodies. - ARYABHATA I - ARYABHATEEYA 499 AD

एको ना योजनान्यष्टौ यात्यन्यो योजनद्वयम् योजनानं शतं पन्थाः संगमः क्व गमागमे ।।  
- One man travels at 8 yojana speed per day. Another travels at 2 yojana per day, starting simultaneously from the same place. After reaching the destination, the first man comes back. If the length of the track is 100 yojana. Say where is the meeting place of the two? (One going forward and the other traveller returning). - SREEDHARACHARYA PATIGANITHA 990 AD

**PROGRESSION OF THE TYPE  $1^2 + 2^2 + 3^2 + 4^2 + \dots$  :** सप्तानां अष्टानां सप्तदशानां चतुर्भुजाश्रितयः । एकविद्यानां वाच्यं पदस्तरास्ता हि वर्गाख्याः ।। - There are (three pyramidal) piles on square bases having 7, 8 and 17 layers which are also squares. Say the number of units there in. - BHASKARACHARYA I - ARYABHATEEYA BHASHYA 628 AD

**PROGRESSION OF THE TYPE  $1^3 + 2^3 + 3^3 + 4^3 + \dots$  :** चतुरश्रघनश्रितयः पञ्चचतुर्नवस्तरा विनिर्देश्याः । एकावयवितास्ताः समचतुरश्रेष्टकाः क्रमशः ।। - There are three pyramidal piles having 5, 4 and 9 cuboidal layers. They are cuboidal bricks (of unit dimension) with one brick in the topmost layer. Find the number of bricks used in them. - BHASKARACHARYA I - ARYABHATEEYA BHASHYA 628 AD

**PROGRESSION OF THE TYPE  $\Sigma n + \Sigma n^2 + \Sigma n^3 + \Sigma n^4$  :** द्विगुणतसैकपदघ्नं सैकपदं प (द) दलहतं भवति । - The number of terms plus one, as multiplied by twice the number of terms plus one, being (further) multiplied by half the number of terms. संकलितकृतिघनानां संकलितसमासमानां मे कथय ।



षण्णां सखे पदानां गणयित्वा यदि विजानासि॥ - Friend, if you know, then say after calculation (i) the sum of successive sum of 6 natural numbers (ii) the sum of the squares of the first 6 natural numbers and (iii) the sum of the cubes of first 6 natural numbers. **FIRST DEGREE INDETERMINATE EQUATION** : मुद्गानां कुडवाः सप्त लभ्यन्ते नवभिः पणैः पणेन कुडव- स्यार्धं तण्डुलानामवाप्यते । ततः पणत्रयं सार्धं गृहीत्वा  $ff$  शु वणिङ्मम तण्डुलानां प्रयच्छांश मुद्गानां च द्विसङ्गुणम्॥ - 7 kudavas (unit of measurement) of mudga are obtained for 9 panas and  $\frac{1}{2}$  kudava of rice is obtained for one pana. Then O! merchant take  $3\frac{1}{2}$  panas and quickly give me one part of rice and two parts of mudga. - **SREEDHARACHARYA - PATIGANITHA 900 AD**

**FIRST ORDER EQUATION - I** : ये निर्झरा दिनदिनार्थं तृतीय षष्ठेः संपूरयन्ति हि पृथक् पृथगेव मुक्ताः । वापीं यदा युगपदेव सखे विमुक्तास्ते केन वासरलवेन तदा वदाशु॥ - By opening 4 inlets separately, one pond gets filled respectively within 1,  $\frac{1}{2}$ ,  $\frac{1}{3}$ , and  $\frac{1}{6}$  days. If all the four inlets are opened together, how much time (in fraction of the day) is required to fill the pond? - **BHASKARACHARYA II - IN LILVATI 1114 AD**

**FIRST ORDER EQUATION - II** : नव गुलिका तप्त(च) रूपकसमासस्त्रयाणां (तु) गुलिकानां । त्रयोदशानां च रूपकाणां तदा किं गुलिकामूल्यम्॥ - If 9 gulika and 7 rupaka are equal to 3 gulika and 13 rupaka, what is the price of one gulika? (the answer can be determined through the same method followed above) - **SREEDHARACHARYA PATIGANITHA 990 AD**

**EQUATIONS OF HIGHER ORDER- I** : वानरकुलत्रिभागः स्वत्र्यंशसमन्वितः सरः प्रययौ । मूलं च पिपासति द्वौ चूततले स्थितौ शेषौ॥ - One third of a troop of monkey with one third of itself has gone to the tank; the square root of the whole troop is afflicted with thirst, and the remaining 2 monkeys are sitting under the mango tree. What is the total number of monkeys?  $\frac{1}{3} a + \frac{1}{9} \sqrt{a} + a + 2 = a$  - **REEDHARACHARYA - PATIGANITHA 990 AD**

**EQUATIONS OF HIGHER ORDER- II** - बाले मरालकुलमूलदलानि सप्त तीरे विलासभरमन्तरगाण्यपश्यम् । कुर्वज्य केलिकलहं कलहंसयुग्मं शेषं जले वद मरालकुलप्रमाणम्॥ - I saw that one half of 7 times of the square root of the total number of swans were slowly moving away in the river. Remaining 2 are playing in water. What is the number of total

swans? (equation:  $7/2 \sqrt{a+2}=a$ ) - BHASKARACHARYA - ULAVATI 1114 AD

PYTHAGORUS THEOREM DISCOVERED BY BOUDHAYANA : समचतुरश्रस्यस्पर्शपरज्जुः द्विष्टावर्ति भूमिं करोति। - The diagonal of a square produces double the area of the square. दीर्घचतुरश्रस्यस्पर्शपरज्जुः पार्श्वमानि तिर्यन्मानि च यत्पृथग्भूते कुरुतस्तदुभयं करोति। - Areas produced separately by the length and breadth of rectangle together equal to the area of the (square) produced by the diagonal. - BOUDHAYANA BOUDHAYANA SULBASUTRA 700 BC

ANGULAR DIMENSIONS : अंगगुणवेदहुताशाः कलिका विकलाः समुद्रजलघयः स्वत्पजलछाष्टशशि घृतिशशिनः कलिकाः शराग्नयो विकलाः त्रिज्याकृतिरष्टनवत्रिभुवो विधे जिनांशज्या॥ -  $3436' 44''$  is radius and  $11818047' 35''$  is square of radius and  $1398' 13''$  is  $R \sin$  of  $24^\circ$  (both are values in radians). - VATESWARA- VATESWARA SIDDHANTA 880

TRIANGLES : त्रिभुजस्य फलशरीरं समदलकोटि भुजाधसंबर्गः। - The area of a triangle is the product of the perpendicular and half the base. - ARYABHATTA I ARYABHATEYA 499 AD कर्णस्त्रयोदश स्यात् पञ्चदशान्यो मही द्विसप्तैव। विषमस्त्रिभुजस्य सखे फलसंख्या का भवेदस्य॥ - What is the area of a scalene triangle in which one lateral side is 13 units, other 15 unit and the base is 14 units. अष्टादशकोच्छ्रयो वंशो वातेन पातितोमूलात्। बह्वृत्वासौ पतितास्त्रिभुजं कृत्वा इव भग्नः स्यात्॥ - A bamboo of height 18 cubits fell by the wind, it falls at a distance of 6 cubits from the root, thus forming a right triangle, where is the break? - BHASKARA I COMMENTARY TO ARYABHATEYA 628 AD

CIRCLE - VALUE OF  $\Pi$  : चतुरधिकं शतमष्टगुणं द्वाषष्टिस्तथा सहस्राणां अयुतद्वय विष्कम्भस्यासन्नो वृत्तपरिणाहः॥ - When 100 increased by 4 multiplied by 8 and added to 62,000 gives an approximate value for the circumference of a circle having diameter 20,000 units. - ARYABHATA I ARYABHATEYA 499 AD अष्टद्वादशषड्काः विष्कम्भस्तत्त्वतो मया दृष्टाः। तेषां समवृत्तानां परिधिफलं मे पृथक् ब्रूहि॥ - Diameter of 3 circles are correctly seen by me to be 8, 12 and 6 units respectively. Tell me separately the circumference and areas of the circles. - BHASKARACHARYA I - 628 AD

SOMAYAJI'S THEOREMS : (1) व्यासाद् वनसंगुणितात् पृथगाप्तं त्र्याघयुग्मिमूलघनैः। त्रिगुणव्यासे स्वमृणं क्रमशः कृत्वापि परिधिरानेषु॥ - Multiply the diameter of a circle with 4 and keep it at different places and divide each with the odd numbers beginning from 3, 5, 7,... as their cubes subtracted by the same value. Repeat this and add/subtract alternatively the results to three times the diameter of the circle to get the circum-

ference with the highest degree of accuracy. This theorem can be mathematically represented as follows: Circumference =  $3D + 4D / (3^3 - 3) - 4D / (5^3 - 5) + 4D / (7^3 - 7) - \dots$  (2) बर्गोर्पुजां वा द्विगुणैर्निरैकैर्वर्गाकृतैर्वर्जित युग्मवर्गैः । व्यासं च षड्घ्नं विभजेत् फलं स्वं व्यासे त्रिनिघ्ने परिधिस्तदास्यात् ॥ - Six times the diameter is divided separately by the square of twice the square of even integers 2,4,6.... minus one, diminished by the squares of even integers themselves. The sum of the resulting quotient by thrice the diameter is the circumference. This can be mathematically written as follows: Circumference =  $3D + 6D([1/2 \times 2^2 - 1]^2 - 2^2) + ([1/2 \times 4^2 - 1]^2 - 4^2) + [(1/2 \times 6^2 - 1)^2 - 6^2] + \dots$  - PUTHUMANA SOMAYAJI - KARANAPADDHATHI 1450 AD

AREA OF CIRCLE AND SPHERE : यत्तक्षेत्रे परिधिगुणितव्यासपादः फलं तत् क्षुण्णं वेदैरुपरिपरितः कन्दुकस्येव जालं । गोळस्यैवं तदपि च फलं पृष्ठजं व्यासनिघ्नं षड्भिर्भक्तं भवति नियतं गोळगर्भं घनाख्यम् ॥ - When circumference is multiplied with diameter and that result divided by 4, that will give the area of a circle. This when multiplied with 4 gives the surface area of the globe which is like surface of a ball. This when multiplied with diameter and divided by 6 gives the volume of the sphere of globe. Mathematically it can be written as  $2\pi r \times 2r/4 = \pi r^2$ . BHASKARACHARYA II - LILAVATI - 1114 A.D

NEWTON GAUSS (1670AD) BACKWARD INTERPOLATION DISCOVERED BY VATESWARACHARYA : घनुषाप्त भुक्त जीवघाते लब्धं सरूपकं दलितम् । लब्धघ्न विवरहतं च संशोध्य नियोज्य विकलज्या ॥ - In modern mathematical form this interpolation formula can be written as  $f(x) = f(x_i) + (x - x_i)1/h Df(x_i - h) + (x - x_i)1/h \cdot (x - x_i + h)1/h \cdot D^2f(x_i - h)1/2$ . - VATESWARA VATESWARA SIDDHANTA 904 AD

ARC AND CHORD : स्वल्पचापच्छघनषष्ठभागतो धिस्तार्द्धं कृतिर्भक्तयर्जितम् । शिष्टचापमिहशिज्जनि भवेत् तद्युतोऽल्पकगुणोऽसकृत्घनुः ॥ - The chord of an arc of a circle is obtained from the result of the cube of the length of the arc divided by six times the cube of radius and subtracted from the arc. This can be mathematically presented as follows: Chord (R Sine q) =  $s - (s^3 / 6r^3)$ . Here length of the arc s is in angular dimensions, r is the radius and q is the angle of the arc. - PUTHUMANA SOMAYAJI - KARANA PADDHATHI - 1450 AD परिधेः षड्भागज्या विष्कम्भार्धने सा तुल्या । - The chord of one sixth of circumference is equal to the radius of that circle. - ARYABHATTA I - ARYABHATTEYA 499 AD



**LENGTH OF ARC - CHORD :** व्यासाब्धियात्पुतमौर्विकया विभक्तो जीवाद्भिपञ्चगुणितः परिधेस्तुवर्गः। लब्धोनितात् परिधिर्वर्ग चतुर्थभागादाप्ते पदे वृत्तिदलात् पतितेधनुः स्यात्॥ -

One fourth of five times the chord multiplied with square of circumference divided by four times the diameter added with the chord. This value is subtracted from one fourth of the square of circumference. Square root of this is taken and subtracted from half of the circumference to get the arc. **ARC AND ARROW :** ज्याव्यासयोगान्तरघातमूलं व्यासस्तदूनो दलितः शरः स्यात्। व्यासाच्छरोनच्छरसंगुणा च मूलं द्विनिघ्नं भवतीह जीवा। जीवार्धवर्गे शरभक्तयुक्ते व्यासप्रमाणं प्रवदन्ति वृत्ते। - When the sum and differences of diameter and the chord are multiplied, and their square root is taken and if half of that is subtracted from the diameter, the arrow is obtained. The difference of diameter and the arrow multiplied with the arrow, twice the square root of that value gives the chord. The square of half the chord divided by arrow and added with arrow gives the diameter of the circle. -

**BHASKARA II - LILAVATI 1114 AD**

**NEWTON'S INFINITE GP CONVERGENT SERIES DISCOVERED BY NILAKANTA SOMAYAJI :** एवं यस्तुत्यच्छेद परमभाग परमपर्यया अनन्ताया अपि संयोगः तस्य अनन्तानां अपि कल्प्यमानस्य योगस्य आद्यावयविनः परस्परमच्छेदाद् एकोनच्छेदामंश साध्यं सर्वत्रापि समानं एव..... - Thus the sum of an infinite series, whose later terms (after the first) are got by diminishing the preceding or by the same divisor, is always equal to the first term divided by one less than the common mutual divisor. - **NILKANTA ARYABHATEYA BHASHAYA 1444**

**SINE, COSINE, RADIUS AND ARC :** अन्योन्यकोटिहतयोरभिमत गुणयोस्त्रिजीवया हतयोः। योगवियोगौ स्यातामभिमतगुणचापयोगविवरगुणौ॥ - The sum of the products of Sin A and Cos B and when angles are exchanged, Sin B and Cos A, gives the Sin of the sum of the angles. Similarly the difference of the above gives the value of the sin of angular difference.  $\sin(A+B) = \sin A \cos B + \cos A \sin B$  And  $\sin(A-B) = \sin A \cos B - \cos A \sin B$ . यद्वेष्टचापगुणत च्छरवर्गयोगमूलार्धमिष्टधनुरर्धगुणः प्रदिष्टः। ज्यानां निजत्रिगुणवर्गविशेषमूलं कोटिस्तदूनसहितौत्रिगुणौस्वभाणौ॥ - Square root, of the square of a chord ( $R \sin q$ ) diminished from squares of radius gives the koti ( $R \cos q$ ). This subtracted from radius gives the (small) arrow of arc. This added to radius is big arrow of the arc..... - **PUTHUMANA SOMAYAJI - KARANA PADDHATI 1450**

**TAYLOR (1685 AD) SERIES OF SINE AND COSINE DISCOVERED BY NILAKANTA**

: इष्टदोः कोटि धनुषोः स्वसमीपसमीरते ज्ये द्वे साययवे न्यस्य कुर्याद् ऊनाधिकं धनुः द्विज्ज तल्लिप्तिकाप्तैक शरशैल शिखीनन्दवः न्यस्याच्छेदाय चमिथास्तत्संस्कार विधित्सया धितवैकां प्रक्षिपेज्जह्यात् तद्धनुष्यधिकोणके अन्यस्यां अथ तां द्विजां तथा'स्यां इति सस्कृतिः संत ते कृत संस्कारे स्वगुणौ धनुषास्तयोः - Placing the sine and cosine chords nearest to the arc, whose sine and cosine chords are required, get the arc difference to be subtracted or added. For making the correction, 13,751 should be divided by twice the arc difference in minutes and the quotient is to be placed as the divisor, divide the one (sine or cosine) by this divisor and add to or subtract from the other (cosine or sine) according as the arc difference is to be added or subtracted. Double this result and do as before. Add or subtract the result to or from the first sine or cosine to get the desired sine or cosine chords. - NILAKANTA - TANTRA SANGRAHA 1444 AD

NEWTON GAUSS (1670) INTERPOLATION FORMULA DISCOVERED BY GOVINDASWAMI: गच्छाद्यात गुणान्तरवपुर्यातेष्य दिधासनाच्छेदाभ्यास समूहकार्मुककृतिप्राप्तात् त्रिभिस्ताडितात् वेदैर्हिवद्भिर् अवाप्तम् अन्त्यगुणजे राशयोः क्रमात् अन्त्यभेः गन्तव्याहक वर्तमानगुणजाच्छापाप्तं एकादिभिः । अन्त्याद् उत्क्रमतः क्रमेण विषमैः सङ्ख्याविशेषैः क्षिपेद्भङ्गत्वाप्तं, यदि मौर्विकाविधिर् अयं माख्यः क्रमात् वर्तते शोध्यं व्युत्क्रमतास्तथाकृतफलं..... - Mathematically this formula is summarised as follows:  $F(x+nh)=Df(x)+nf(x)+\frac{1}{2}n(n-1)(Df(x)-Df(x-h))$  Multiply the difference of the last and the current sine differences by the square of the elemental arc and further multiply by three. Now divide the result so obtained by four in the first rasi, or by six in the second rasi. The final result thus obtained should be added to the portion of the current sine difference (got by linear proportion). In the last rasi, multiply the linearly promotional part of the current sine differences by the remaining part of the elemental arc and divide by the elemental arc. Now, divide the result by the odd numbers according to the current sine difference, when counted from the end in the reverse order. Add the final result thus obtained to the portion of the current sine difference. These are the rules for computing true sine differences for sines. In the case of versed sines, apply the rules in the reverse order and the above corrections are to be subtracted from the respective differences. - GOVINDASWAMI - COMMENTARY FOR MAHABHASKAREEYA 800 AD

NEWTON'S (1660 AD) POWER SERIES DISCOVERED BY SOMAYAJI : निहत्य चापवर्गेण चापं तत्तत् फलानि च हरेत् समूलयुग्मवर्गैस्त्रिज्यावर्गहतैः क्रमात् चापं फलानि चाधोघोन्यस्योपर्युपरि त्यजेत् जीवाप्त्यै, संग्रहो/स्यैव विद्वान् इत्यादिनाकृतः निहत्य चापवर्गेण रूपं तत्तत् फलानि च हरेद् विमूलयुग्मवर्गैस्त्रिज्यावर्ग हतैः क्रमात् किन्तु व्यासदलेनैव द्विघ्नेनाद्य विभज्यतां फलान्यधोघः क्रमशोन्यस्योपर्युपरि त्यजेत् शराप्त्यै, संग्रहो/स्यैव स्तेनस्त्रीत्या दिनाकृतः

Multiply repeatedly the arc by its square and divide by the square of even numbers increased by that number and then multiplied by the square of radius. Place the arc and result one below the other and subtract each from what is above it. To derive the arc, which are collected, beginning with the expression *Vidvan* (katapayadi number). Multiply repeatedly, the unit measurement which is the radius, by the square of the arc and divide by the square of even numbers decreased by that number and then multiplied by the square of radius; the first is, however, to be divided by twice the radius. Place the results one below the other and subtract each from the one above it. That is the method to derive the *saras*, which are collected in the beginning with *stena*. (This equation is now known as Newton power series.) - **PUTHUMANA SOMAYAJI - KARANAPADDHATI (1450 AD)**

VOLUMES OF CONES : समखातफलत्रयंशैः सूचीखाते फलं भवति । - The one third of the volume of the uniform cylinder is the volume of the cone. परिधिर्भित्तिलग्रस्य राशेस्त्रिंशत्करः किल अन्तकोणस्थितस्यापि तिथितुल्यकरः सखे । बहिष्कोण स्थितस्यापि पञ्चघ्ननव सम्मितः तेषामाचक्ष्व मे क्षिप्रं घनहस्तात् पृथक् पृथक् ।। - Friend, the food grains are kept at a circumference of 30 cubit in the floor, outside corner of the room, inside corner and side of the wall. Find out the volume of the grain if the height is 45 cubit. - **BHASKARA II LILAVATI 1114 AD**

LHUIER'S (1782 AD) FORMULA DISCOVERED BY SOMAYAJI - दोष्णाम्द्वयोर्द्वयोर्घातयुतानां तिखाणां वधात् एकैकोनेतरात्रैक्यं चतुष्कवधाभाजितं लब्धमूलेन यदवृत्तं विष्कम्भार्धे निर्मितं सर्वं चतुर्भुजक्षेत्रं तस्मिन्नेव तिष्ठहते - The three sums of the product of sides, taken two at a time are to be multiplied together and divided by the product of the sums of the sides taken three at a time and diminished by the fourth. If a circle is drawn



with the square root of this quantity as radius, the whole quadrilateral will be situated inside it. - PARAMESWARA COMMENTARY FOR LILAVATI (1360 AD)

**GREGORY'S (1632 AD) SERIES FOR INVERSE TANGENT DISCOVERED BY MADHAVA CHARYA**

इष्टज्यात्रिज्ययोर्घातात् कोट्याप्तं प्रथमं फलं ज्यावर्गं गुणकं कृत्वा कोटिवर्गं च हारकं प्रथमादिफलेभ्यो/य नेया फल कृतिर्मुहुः एक त्रयाद्योज संख्याभिरभक्तेष्वेतेष्वनुक्रमात् ओजानां संयुतेस्त्यक्त्वा युग्मयोगं धनुर्भवेत् दोः कोट्योरलपमेवेह कल्पनीयं इहस्मृतं लब्धीनां अवसानं स्यान्न तथापि मुहुः कृते - Obtain the first result of multiplying the ज्या (R sine q) by the त्रिज्या (radius) and dividing the product by कोटी (R cos q). Multiply this result by the square of the ज्या and divide the square by the कोटी. Thus we obtain a second result a sequence of the further results by repeatedly multiply by the square of the ज्या and dividing by the square of the कोटी. Divide the terms of the sequence in order by the odd numbers 1,3,5,...; after this, add all the odd terms and subtract from them all the even terms (without disturbing the order of the terms). Thus is obtained the dhanus whose two elements are the given ज्या and कोटी. (Here the smaller of the two elements should be taken as the ज्या, since other wise the series obtained will be non finite) (use of Tangent) - MADHAVA YUKTI BHASHA? (1350 AD)

**LEBNITZ (1673 AD) POWER SERIES DISCOVERED BY SOMAYAJI :** व्यासे चारिधि निहते रूपहते व्यास सागराभिहते त्रिशरादि विषमसंख्या भक्तमृगं स्वं पृथक् क्रमात्कुर्यात्॥ - Multiply the diameter by 4. Subtract from it and add to it alternately the quotients obtained by dividing four times the diameters by the odd integers 3, 5, 7,.... This will give the fine value of the circumference i.e  $\pi/4 = 1 - 1/3 + 1/5 - \dots$  - PUTHUMANA SOMAYAJI - KARANAPADDHATI (1440 AD)

**DE MOIVRE'S (1650 AD) APPROXIMATION DISCOVERED BY MADHAVA CHARYA :** अस्मात् सूक्ष्मतरान्यो विलिख्यते कश्चनापि संस्कारः अन्ते सम संख्यादलवर्गसैको गुणः स एव पुनः । युगगुणितो रूपयुतः समसंख्यादलहतो भवेद् हारः त्रिशरादि विषमसंख्या हरणात् परं एतत् एव वा कार्यम्॥ - A correction for circumference still more precise is being stated here. The multiplier is the square of half the even integer increased by unity. This multiplier multiplied by 4, then increased by unity and then multiplied by half the even integer is the divisor. This correction may be applied after

the division by odd integers, 3, 5, etc. i.e. Circumference =  $4D (1 - 1/3 + 1/5 - 1/7 + \dots + (-1)^{n/2} / n + 1/n^2 + 1)$ ,  $((1/2(n+1))^2 \times 4 + 1) (1/2(n+1))$  - MADHAVA KRIYA KRAMAKARI (1350 AD)

DE MOIVRE'S (1650 AD) APPROXIMATION : यत्संख्यायात्र हरणे कृते निवृत्ताहतिस्तु जामितया तस्या ऊर्ध्वगतास्यास्समसंख्या तदलं गुणे/न्ते स्यात् तद्वर्गैरुपहतो हारो व्यासाध्याततः प्रग्वत् तस्यां आप्तं स्वमृणे कृते घने शोधनान्च करणीयं सूक्ष्मः परिधिः सा स्यात् बहुकृत्वो हरणतो/तिसूक्ष्माश्च - ..... Let the process stop at a certain stage, giving rise to a finite sum, multiply four times the diameter by half the even integer subsequent to the last odd integer used as divisor and then divide by the square of the integer increased by unity. The result is the correction to be added to or subtracted from finite sum. The choice of addition or subtraction is depending on sign of the last term in the sum. The final result is the circumference determined more accurately than by taking a large number of terms: - MADHAVA YUKTIBHASHA? (1350 AD)

HORIZON : आवेष्टमानमय तानि दलप्रवृत्त्या यद्वृत्तमत्र हरिजं क्षितिजं तदाहुः यस्मिन् भवेत् समुदयोस्तमयोखिलानां प्राच्यां क्रमादपरदिश्युद्बुद्धेचराणां - The great circle which goes round them, dividing each of them into two equal parts, is called harija or kshitija. This in modern astronomy is horizon. This is the circle on which rising and setting of stars and planets take place towards east and west respectively. - VATESWARA SIDDHANTA 880 AD

ASTRONOMICAL DEFINITIONS : ऊर्ध्वमधो/परपूर्वमिहाद्यं प्राहुरिदं सममण्डलमन्यत् । तद्वदिहोत्त रदक्षिणदिक्स्थं वृत्तयुगं विदिशोरपि तद्वत् ।। - Vertical circle passing through the west and east cardinal points is the first circle: this is called the samamandala. (This circle is the prime vertical. Another similar vertical circle (called the yaamyottara-vrutta) which passes through the north and south cardinal points is called the meridian. - VATESWARA - VATESWARA SIDDHANTA 880 AD

TYCHO BRAHE REDUCTION OF ECLIPTIC DISCOVERED BY ACHYUTA PISHAROTI : पातो नस्य विधोस्तु कोटिभुजयोर्जीवे मितस्ताडयेत् अन्त्यक्षेप शराहतं वधममुं विलेपकोट्याहरेत् । लब्धं व्यासदलोद्धृतं हिमकरे स्वर्गे विपाते विधौ युग्मायुग्मपदोपगे विधुरयस्स्पष्टो भगोले भवेत् ।। - Multiply the tabular cosine and sine of the moon minus node and the product by the tabular versine of the

maximum latitude of the moon. Divide this by the tabular cosine of the latitude at the particular moment and the quotient is to be divided again by the tabular radius. The result is to be added to or subtracted from the moon's longitude, as the moon minus node is in an even or an odd quadrant, respectively. The true moon measured on the ecliptic is thus obtained. - **ACHYUTA PISHAROTI SPHUTANIRNAYA**

**EQUATOR :** खस्वस्तिकाद् दक्षिणतोक्षिभागौ पाता(ल) संज्ञाच्च तयोत्तरेण । नाड्यङ्कितं वैषुवतं तदुक्तं वृत्तं भगोलस्य खगोलमध्ये ॥ - The sphere of the asterisms lie within the sphere of the sky. Great circle of the sphere of asterisms which lies towards the south of the zenith by an amount equal to the degrees of local latitude and towards the north of nadir by the same amount and which is graduated with the division of nadis is the vishuvathvrutta. This circle is called the equator. **6 O'CLOCK CIRCLE -** पुर्वापरक्षितिजसङ्गमयोगतज्ज्व याम्यादघः पललवैः क्षितिजा द्विलग्नं सौम्यादयोपरि समघ्रुवमार्गं संस्यमुन्मण्डलं दिननिशोः क्षयवृद्धिकृतात् - Passing through the two points of intersection of prime vertical and horizon, lying below the south cardinal point by the degrees of local latitude, fastened to the horizon, and lying above the north cardinal point, passing through the north celestial pole, is the Unmandala, the cause of decrease and increase of the day and night. (This in modern astronomy is known as the 6'o clock circle.) **CIRCLE OF DIURNAL MOTION :** हरिजे परपूर्वमण्डलद्युज्यावृत्तविशेषशिञ्जिनी । उदयाग्रगुणो घुमण्डले भूज्योदवृत्तकुजान्तरांशजीवाः ॥ - R sine of the arc of the horizon lying between the prime vertical and the diurnal circle of the planet is the R sine of agra (now known as the rising point of the planet) and the R sine of the degrees of diurnal circle lying between six o' clock circle and the horizon is bhoojya (bhujya) which is termed as Earthsine. **DAY RADIUS :** क्रान्तिज्यावर्गानात् त्रिज्यावर्गात्पदं घुजीवा स्यात् । त्रिज्याक्रान्तिज्यान्तरसमासघातस्य मूलं वा ॥ - Day radius is equal to the square root of the difference obtained by subtracting the squares of R sine of the declination from the square of the radius or the square root of the product of the difference and the sum of the radius and the R sine of the declination. **ECLIPTIC :** नाड्याह्ववृत्ते/जितुलादिलग्नं जिनांशकैर्दक्षिणतो मृगादौ । सौम्ये शीतमन्दिरादावपक्रमाख्यं



तदुशन्ति वृत्तम्॥ - Fastened to the so called nadivrutta or the equator at the points of Aries and Libra and lying 24 degrees of the south (of equator) at the first point of Capricorn and 24 degrees to the north (of equator) at the first point of Cancer, there is a great circle called the apakrama vrutta (now known as the ecliptic) - **VATESWARA SIDDHANTA 880 AD**

DAY DIAMETER : विषुवज्या/पियार्धवर्गविश्लेषमूलमवलम्बकः। क्रान्तित्रिज्या कृत्योरन्तरपदं द्विगुणं दिनव्यासः॥ - Square the sine of latitude and deduct from the square of the radius. Its square root is the sine of the co-latitude (its arc being the co-latitude). Square the sine of the declination deduct from the square of the radius and find its root. Twice the result is the day diameter. - **PANCHASIDDHANTIKA 4-23 - VARAHA MIHIRA 505 AD**

SETTING POINT OF ECLIPTIC : प्राच्याकुजापक्रमवृत्तसङ्ग प्राग्लग्नमाहुः (परितो/स्त लग्नं)। (लग्नाद्भवेत्) स (प्त) म (रा) शि (र) स्त तस्या (स्त) कालो भ्युदयो/स्य भूयात्॥ - Point of intersection of horizon and the ecliptic in the eastern half of the celestial sphere is called praglagna. I.e. the rising point of ecliptic; the same in the western half is called astalagna, known as setting point of ecliptic. **RISING - SETTING LINE** : व्यासार्धवृत्ते/न्तरमेतयोः स्याच्चरार्धजीवा परपूर्वयोस्तत्। अग्राग्रयोर्धद् हरिजे निबद्धं सूत्रं ग्रहाणामुदयास्त संज्ञम्॥ - The arcual distance between the six o'clock circle and the horizon measure, along the R circle trijyavrutta known as great circle of the celestial sphere, supposed to be of radius 3438' (minute of angle) is the charardhajya. It is called the R sine of the Ascensional difference. A thread tied to the extremities of the agra on the eastern and western halves of the horizon is called the udayaastasutra. (In modern astronomy it is known as the rising - setting line of planets). - **VATESWARA SIDDHANTA 880 AD**

DAY RADIUS AND EARTHSINE : क्रान्तित्रिभान्तरज्या ध्रुज्या वा चरदल जीवया हृता त्रिज्याक्षिति जीवघ्ना स्वाहोरात्रार्धजीवा वा॥ - Rsine of the difference between the three signs and the declination is also equal to the day radius. Day radius multiplied by earthsine and divided by the R sine of the Ascensional difference gives the day radius.

**SUN'S PRIME VERTICAL :** ऊर्ध्वमधोऽपरपूर्वमिहाद्यं प्राहुरिदं सममण्डलमन्यत् । तद्वदिहोत्तरदक्षिणदिक्स्थं वृत्तयुगं विदिशोरपि तद्वत् ॥ - Vertical circle passing through the west and east cardinal points is the first circle called samamandala or the prime vertical. - VATESWARA SIDDHANTA - GOLA. 3-1, 2 - 880 AD

**PARALLAX-I :** तिथेर्नतस्य क्रमशिञ्जिनी हता ह्यमध्यलग्नप्रभवेन शङ्कुना । क्षमाषडङ्काब्धिशराङ्कनेत्रहृद् विलम्बने स्याद् घटिकादि वा फलम् ॥ - R sine of the hour angle at the amavasya multiplied by R sine of the altitude of the meridian ecliptic point and divided by 2954961 gives the parallax in ghatikas at mid eclipse. **PARALLAX-II :** त्रिराशिजीवा बलनज्यका हता शिलीमुखैरङ्गुलतां व्रजन्ति ताः द्विसङ्गुण दृष्टिगतिः शराचलैर्विभाजिता लम्बननाडिका फलम् - Radius and the valanajya when divided by 5, are converted into angulas. The R sine of driggati multiplied by 2 and divided by 75 gives ghatika of the parallax in longitude. **PARALLAX-III :** नतक्रमज्याम्बरशङ्कुनिघ्ना स्याल्लम्बनं तत्परसेषुहृद्वा दृक्षेप भुक्त्यन्तरयोश्च घातः खवाणयुग्मक्षिप्तो नतिः स्यात् - R sine of the hour angle multiplied by Rsine of altitude of the meridian ecliptic point and divided by 5625 gives parallax in longitude. The Difference of true motions of the Sun and the moon multiplied by the Rsine of drikshepa and divided by 2250 gives the parallax in latitude. (Sishyadhi vruddhi Tantra 13-12) **APOGEE, PERIGEE AND ORBIT OF EARTH :** स्वोच्चात् षड्भागाध्यधिको यदा तदा भवति स्वनीचस्थः । दूरेणोच्चग उर्व्याः कर्णवशान्नोच्चगो निकटे ॥ - When a planet is at a distance of 6 signs from its apogee, it is said to be at the perigee or neecha. When a planet is at the apogee, it is farthest from the earth when at the perigee, it is nearest to the earth. This is so because of the length of the hypotenuse in each case (Sishyadhi vruddhi Tantra 14-10) **SHAPE OF EARTH :** गगनमरुदाग्निजलमृण्मयो महाभूतगुणयुतः स्वस्थः । कलाभिरावृतोऽपि भषज्जरान्तश्च भूगोलः ॥ - Spherical earth, made of ether, fire, air, water and clay (Panchabhoothas) and thus have all the properties of the five elements, surrounded by the orbits and extending upto the sphere of stars, remain in the space प्रगुणःपरिधेः शतांशको गणितज्ञाः कथयन्ति दृश्यते । प्रतिभाति तदा समा मही विषये यत्र तथैव गम्यते ॥ - Mathematicians say that one hundredth of the circumference of the earth

appears to be plane. So, that portion of the earth appears to be plane to an observer (Sishyadhi vruddhi Tantra 20-35) .  
**LALLACHARYA SISHYADHI VRUDDHI TANTRA 700 AD**

**ROTATION OF EARTH - I** - प्राणेनेति कलां भूर्यदि तर्हि कुतो व्रजेत् कमध्यानम् आवर्तनं मुर्व्याश्चेन्न पतन्ति समुच्छ्रयाः कस्मात् ।। If earth rotates at a speed of 1' of an angle in 4 seconds, will not the things on the loft fall? Where does the earth go in this speed? (Brahmasphuta siddhanta 11-17). - **BRAHMAGUPTA BRAHMASPHUTA SIDDHANTA 629 AD**

**FOUR QUADRANTS OF EARTH** : उदयो यो लङ्कायां सोऽस्तमयः सवितुरेव सिद्धपुरे । मध्याह्नो यवकोट्यां रोमकविषयेर्धिरात्रं स्यात् ।। - When it is Sunrise in Lanka, the same Sun sets in Siddhapura. (Gautimaala). It is noon in Yavakoti (Korea) and midnight in Romaka (Rome) (Aryabhateeyam 4-13) - **ARYABHATA -I (499 AD)**

**GLOBE** : समवृत्तपृष्ठमानं सूक्ष्मं गोलं प्रसाध्य दारुमयं स्थगितार्कं समाङ्कितकाल भोगरेखाद्वये परिधौ ।। - Perfectly circular throughout and spherical, made of wood, marked with degrees and minutes, incorporated with lines both longitude and latitude at ends, is the golayantra. (Panchasiddhantika 14-23) - **VARAHAMIHIRA PANCHASIDDHANTIKA (505 AD)**

काष्ठमयं समवृत्तं समन्ततः समगुहं लघुं गोलं पारदतैलजलेस्तं भ्रमयेत् स्वधिया च कालसमं ।। - Made of wood, fully circular, uniform, equally dense throughout and spherical shaped golayantra, which rotates at a fixed rate of time as the earth does by the help of mercury, oil and water, by the application of our intelligent calculation, is the golayantra-Globe. - नृषियोजनं, त्रिला भूव्यासो ..... - 8000 Nr units is equal to one yojana. The diameter of earth is 1050 yojana.

**ROTATION OF EARTH - II** : कु ङि शि बु ण् लृ ष् ख प्राक् ..... - Eastward rotations of the earth in one Yuga is 1582237500 अनुलोम गतिर्नोस्यः पश्यत्यवलं विलोमं यद्वत् । अचलानि भानि तद्वत् समपश्चिमगानि लङ्कायाम् ।। - Just as a man in a boat moving forward sees the stationary objects as moving backward, so are the stationary stars and celestial bodies seen by the people at equator (Lanka) as moving exactly towards west. ....कु आवर्तश्चापि नात्राः ।। - The rotation of the earth is the cause of days (Aryabhateeyam 3-5). - **ARYABHATA-I ARYABHATEEYA (499 AD)**



**MERIDIAN :** लङ्कायामेकं शङ्कुकीलं प्रतिष्ठाप्य तेनैकं सूत्राग्रं बद्ध्वा पुनर्मरुपरि तदग्रमन्यत् बद्ध्वा यथा यथा दृश्यते.... तद्वत् भूमावपि काचिद्रेख। लङ्कातः खरपुरतः मेरुमस्तकान वगाह्य स्थिता सा पुनरत्रा-देशान्तरविधायिनी स्यात्॥ - Fix a pole in Lanka, tie thread on that, take the other end to the North pole, tie it there also, then one can see the line of the thread passing through Lanka, Kharapuri, Arctic point and so many other countries upto the top of Meru. This is international meridian line (Sankaranarayana on Laghubhaskareeya I-23) - SANKARANARAYANA I LAGHUBHASKAREEYA (950 AD)

**GRAVITY :** आकृष्टिशक्तिश्च मही तथा यत् खस्यं गुरु स्वाभिमुखं स्वशक्त्या। आकृष्यते तत्पततीव भाति समे समन्तात् क्व पतत्ययं खे॥ - This earth attracts whatever solid materials are in the space, by her own force of attraction towards her (earth). All those subjected to this attractional force fall, to the earth. Due to equal force of attraction among the celestial bodies, where can each among them fall? (Siddhanta siromani Bhuvanakosham 6) - BHASKARA II SIDDHANTA SIROMANY (1114 AD)

**MERIDIAN AND TIME :** देशान्तरघटीकुण्ठा मध्या भुक्तिर्घुचारिणां षष्ट्या भक्तमृणं प्राच्यां रेखायाः पश्चिमे घनम्॥ - The time is calculated based on the meridian. Divide the time by 60... and the longitude is calculated. Towards the east subtract and towards the west add the number (Laghubhaskareeyam 1-31) - BHASKARA I LAGHUBHASKAREEYA (628 AD)

**MERIDIAN AND TIME :** पञ्चाशता त्रिभिस्त्रयंशसंयुतैर्योजनैश्च नाह्येका। समपूर्वं पश्चिमस्यैर्नित्यं शोघ्या च देया च॥ - One nadi for every 53 1/3 yojanas has to be deducted or added (to Ujjaini) by the people in places east and west, respectively of the Ujjaini meridian. (Panchasiddhantika 9-10) - VARAHAMIHIRA - PANCHASIDDHANTIKA (605 AD)

**ECLIPSE-I :** किमर्थं असुरः कश्चिद्राहुर्नाम संहिकेयो किं चन्द्रं च ग्रसत इति श्रूयते। सपि पौराणिक श्रुतिरेव। कः पुनरिह राहुरित्युच्यते॥

What does it mean that Asura is responsible for the eclipse? Others say that a snake Rahu swallows the Sun and the Moon! Those are puranic stories! Then what is called the Rahu? -

SANKARANARAYANA COMMENTARY TO LAGHUBHASKAREEYA 950 AD छदयति

शशी सूर्य, शशिनं महती च भूछाया । - Moon covers (shadows) the Sun and the great shadow of the earth covers the moon (which causes the eclipse) - ARYABHATA I ARYABHATEEYA (499 AD)

ECLIPSE-II : अत एव भूछाया चन्द्रग्रहणस्य कारणं - That is why it is said that the shadow of the earth is the cause for the lunar eclipse. - SANKARANARAYANA COMMENTRAY TO LAGHUBHASKAREEYA

असुरो यदि मायया युतो नियतो/तिग्रसतीति ते मतम् । गाणितेन कथं स लभ्यते ग्रहकृत्वर्च विना कथञ्चन ।। - If you are of the opinion that an artifical demon is always the cause of an eclipse by swallowing, then how is it that an eclipse can be determined by means of calculations. Moreover why is then not an eclipse occur on a day other than the day of new or full moon - LALLACHARYA SISHYADHI VRUDDHI TANTRA 700 AD

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